PHYSICAL ACTIVITY, SEDENTARY BEHAVIOUR AND DEPRESSION AMONGST SOCIO-ECONOMICALLY DISADVANTAGED WOMEN

BY

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There is now good evidence that physical activity is associated with reduced risk of morbidity and/or mortality from a range of chronic conditions. This includes evidence suggesting a beneficial effect of physical activity on mental health outcomes, such as depression. However, little research has investigated the types of physical activities (i.e. the domain and social context) that are most beneficial in reducing the risk of depression. Furthermore, sedentary behaviour (e.g. television viewing, sitting at the computer) has been linked to an increased risk of a range of chronic health conditions, yet little is known about its link with depression. Since socio-economically disadvantaged women are at an increased risk of depression as well as physical inactivity and high levels of sedentary behaviour, they are an important target group for physical activity research and promotion initiatives. Despite this, there is a lack of research investigating the influences on physical activity and sedentary behaviour amongst disadvantaged women with depressive symptoms. Furthermore, little is known about the most effective strategies to promote physical activity and reduce sedentary behaviour amongst this target group.

This thesis investigates these important research gaps. Four inter-related studies were conducted, to describe the associations between components of physical activity, sedentary behaviour and risk of depression; to determine the influences on physical activity and sedentary behaviour amongst disadvantaged women with depressive symptoms; to identify the mediating factors which may help explain
the inverse relationship between sedentary behaviour and socio-economic position and to examine the perceived feasibility and effectiveness of potential strategies to increase physical activity and reduce sedentary behaviour amongst socio-economically disadvantaged women. The first study, a cross-sectional, population-based survey of women living in socio-economically disadvantaged neighbourhoods, examined the association between various components of physical activity (e.g. domain and social context), sedentary behaviour (e.g. television viewing, sitting time and computer use) and risk of depression. In the second study, a series of one-on-one telephone interviews were conducted amongst a sub-sample of women living in disadvantaged neighbourhoods and experiencing depressive symptoms to identify the perceived influences on physical activity and sedentary behaviours, as well as potential strategies to increase physical activity and reduce sedentary behaviour amongst this target group. The third study, a cross-sectional, population-based survey of women, examined the role of several intra-personal, social and physical environmental factors in mediating socio-economic gradients in women’s television viewing, a common form of sedentary behaviour amongst women. Insights from those studies led to the development of the fourth study, a qualitative survey which examined the perceived feasibility and effectiveness of two intervention approaches (one print-based and one web-based) designed to promote physical activity and reduce sedentary behaviour amongst women living in a socio-economically disadvantaged neighbourhood.
The studies presented in this thesis demonstrated that participation in leisure-time physical activity and transport-related physical activity were associated with lower risk of depression amongst women living in socio-economically disadvantaged neighbourhoods. However, no associations were apparent for domestic or work-related physical activity. In addition, women who undertook a small proportion of their leisure-time physical activity with someone else (i.e. in a social context) were less likely to be at risk of depression than those who undertook all leisure-time physical activity on their own. Moreover, women reporting greater time sitting at the computer, in screen time and overall sitting time had higher odds of risk of depression compared to those reporting low levels.

Although women at risk of depression mentioned finding it difficult to be physically active when feeling down, they did recognise the impact exercising had on managing depressive symptoms. Other perceived influences on physical activity amongst women at risk of depression and living in socio-economically disadvantaged neighbourhoods included feeling tired, lack of time, negative atmospheres of recreational clubs, having children, social support, cost, and safety in the neighbourhood. Women mentioned using television as a tool for ‘switching off’ when feeling depressed. Other perceived influences on sedentary behaviour in this target group included childhood television habits and having children. Potential strategies that were suggested by women to increase physical activity and reduce sedentary behaviour included multi-tasking, public awareness campaigns, childcare facilities, family and friend support, mothers’ physical
activity groups, provision of information on available facilities, and women’s only gyms/classes.

The relationship between women’s socio-economic position (education) and television viewing was partly mediated by intra-personal factors including enjoyment of television and weight status, as well as by social factors including social support from friends and social cohesion within the local neighbourhood. However, none of the selected physical environmental factors were found to be significant mediators of socio-economic variations in women’s television viewing.

Women living in socio-economically disadvantaged neighbourhoods perceived the use of a locally relevant information booklet as a feasible strategy to increase physical activity and reduce sedentary behaviour. Although most women appreciated the level of information and found the presentation style easy to understand, a few women suggested the booklet lacked personal tailoring as well as providing unrealistic tips for increasing physical activity and reducing sedentary behaviour. Weight loss information and seasonal tips (e.g. tips on being active in different seasons) were mentioned as additional forms of information that would help motivate women to be active. More than half the women felt that the information booklet would be best delivered through leaflets in the mail, although other suggestions included reference books (i.e. delivering all the information in one book), websites, e-mails and i-phone applications. Although most women mentioned that the web-based intervention (i.e. online activity
calendar) was well-presented, motivational and would help with planning weekly physical activity, most felt it would be too time-consuming to commit to. Linking the calendar to an existing diary system was suggested to overcome this barrier. It was evident that many women preferred the information booklet as a strategy to increase physical activity and reduce sedentary behaviour, yet several women suggested that using the information booklet in conjunction with the online activity calendar would be most effective.

The results of this PhD research program suggest that promoting physical activity, particularly for leisure and transport, could be an important aspect in preventing depression amongst women living in disadvantaged neighbourhoods. Furthermore, mental health guidelines may be developed to include some aspect of social/accompanied leisure-time physical activity for additional mental health benefits, as well as recommending reducing time spent in sedentary behaviours in order to further reduce risk of depression. Since physical activity and sedentary behaviours amongst women with depressive symptoms are associated with several intra-personal, social and physical environmental factors, there is a need for dynamic and multi-dimensional strategies to increase physical activity and reduce sedentary behaviour. However, interventions aimed at reducing the socio-economic inequalities in television viewing amongst women may need to focus particularly on intra-personal and social factors such as providing women with enjoyable relaxation alternatives to television viewing and enhancing social cohesion within disadvantaged neighbourhoods. An individually-tailored and multi-component approach may be effective in promoting an active lifestyle...
amongst women living in disadvantaged neighbourhoods. Future research should focus on increasing promotion and education about the independent mental and physical health risks linked to engaging in long periods of sedentary behaviour. These findings could inform the development of future intervention strategies in order to improve mental health through the promotion of an active lifestyle and reduction of sedentariness, particularly in women of low socio-economic position.
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“Happiness is a thing to be practiced, like the violin” John Lubbock
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CHAPTER 1: Introduction

Physical activity is important for physical health (Hu et al., 2005; Manson et al., 1999). Research has suggested the beneficial effect of physical activity on mental health, particularly depression (Teychenne, Ball, & Salmon, 2008b), yet little is known as to what types of physical activities (i.e. the domain and social context) may be most beneficial in reducing the risk of depression. Similarly, sedentary behaviour such as television viewing and sitting at the computer have been linked to an increased risk of chronic illnesses such as cardiovascular disease, obesity (Owen et al., 2010) and type 2 diabetes (Proper et al., 2011). However, little is known about links of these behaviours with depression.

Since socio-economically disadvantaged women are at risk of both physical inactivity (Gidlow et al., 2006; Sisson & Katzmarzyk, 2008), and depression (Lorant et al., 2003; Wilhelm et al., 2003), they are an important target group for research and health promotion interventions. Further, socio-economically disadvantaged adults are at risk of engaging in high levels of sedentary behaviours such as television viewing (King et al., 2010; Stamatakis et al., 2009). Despite this, little is known about the influences on physical activity and sedentary behaviour amongst disadvantaged women with depressive symptoms, or the reasons why disadvantaged women are more likely to engage in sedentary behaviours than more advantaged women. Furthermore, there is a lack of research investigating the feasibility of strategies to promote physical activity and reduce sedentary behaviour amongst this ‘at-risk’ target group. The aim of this PhD thesis is to investigate these important research gaps in order to inform targeted
intervention strategies to increase physical activity, reduce sedentary behaviour and in turn reduce the risk of depression amongst socio-economically disadvantaged women.

Chapters 2 and 3 (i.e. Literature reviews Part 1 and 2) present an overview and critique of existing literature relevant to the research topic of physical activity, sedentary behaviour and risk of depression amongst socio-economically disadvantaged women. In particular, Chapter 2 examines the literature that has assessed the associations between physical activity, sedentary behaviour and risk of depression. Chapter 3 examines the literature that has assessed the correlates of physical activity and sedentary behaviour, as well as potential intervention strategies used to increase physical activity. The specific aims of this thesis are also presented there. The four studies that were conducted as part of this thesis are presented in the four subsequent chapters.

Chapter 4 (Study One) presents the results from a cross-sectional study using survey data that was designed to investigate associations between components of physical activity (e.g. domain and social context) and sedentary behaviours, and risk of depression in women from socio-economically disadvantaged neighbourhoods across Victoria. Chapter 5 (Study Two) describes the findings from a qualitative study assessing the perceived influences on physical activity and sedentary behaviour amongst women living in socio-economically disadvantaged neighbourhoods and experiencing depressive symptoms, as well as potential strategies to increase physical activity and reduce sedentary behaviour.
amongst this target group. The Social Ecological Model formed the theoretical basis upon which this study was based.

Chapter 6 (Study Three) presents the results from a cross-sectional study using survey data that was designed to examine the role of several intra-personal, social and physical environmental factors in mediating socio-economic gradients in women’s sedentary behaviour (television viewing). Chapter 7 (Study Four) presents the results of a qualitative study that aimed to test the perceived feasibility of two pilot intervention approaches (one print-based and one web-based) designed to promote physical activity and reduce sedentary behaviour amongst women with and without depressive symptoms living in a socio-economically disadvantaged neighbourhood. The findings from the earlier studies as well as previous research on physical activity interventions founded the ideas for the development of the intervention materials used in that study.

Chapter 8 provides a synthesis of results from all four studies presented in this thesis. Findings are discussed with reference to previous research, as well as in the context of how they may be used to inform the development of targeted intervention strategies to increase physical activity, reduce sedentary behaviour and in turn reduce the risk of depression amongst socio-economically disadvantaged women.
CHAPTER 2: Literature review (Part 1)

2.1. Introduction

2.1.1. Physical Activity

Substantial evidence from observational and intervention studies indicates that physical activity is associated with considerable health-related benefits, such as a reduced risk of Type 2 diabetes (Hu et al., 2005; Manson et al., 1999), cardiovascular disease (CVD) (Blair et al., 1989; Leon, Myers, & Connett, 1997; Manson et al., 1999; Morris et al., 1980), obesity (Coakley et al., 1998; Haapenan et al., 1997), and various forms of cancer (Dosemeci et al., 1993; Hirose et al., 1996), including breast cancer (Vena et al., 1987). In fact, physical inactivity has been found to be one of the most significant modifiable causes of disease in developed countries including the United States of America (US Department of Health and Human Services, 2000) and Australia (Begg et al., 2008).

The Australian health-related physical activity guidelines (Commonwealth Department of Health and Aged Care, 1999b) were developed in order to provide health authorities with an indication of the dose (duration, frequency and intensity) of physical activity required for improving and maintaining general

† Two excerpts from this chapter have been published and are attached in Appendices 1 and 32: Teychenne, M., Ball, K., Salmon, J. 2010, ‘Sedentary behaviour and depression among adults: A review’ International Journal of Behavioural Medicine, 17(4); 246-254. Teychenne, M., Ball, K., Salmon, J. 2008, ‘Physical activity and likelihood of depression in adults: A review’ Preventive Medicine, 46(5); 397-411.
health, and reducing the risk of disease. These guidelines recommend that all adults accumulate at least 30 minutes of moderate-intensity physical activity on most, if not all days of the week (Commonwealth Department of Health and Aged Care, 1999b), and are generally consistent with those of other developed countries including the United States of America (Haskell et al., 2007) and the United Kingdom (Chief Medical Officer’s Report, 2004). Further, such guidelines emphasise moderate ‘lifestyle’ physical activity as a means for achieving the recommendations (Haskell et al., 2007; Pate et al., 1995). ‘Lifestyle’ physical activity refers to physical activity undertaken in different domains and includes domestic (or household) physical activity; transport-related physical activity; occupational physical activity and leisure-time physical activity.

Despite a growing understanding of the importance of physical activity, at least 40% of the Australian population do not meet the health-related guidelines (Department of Health, 2008). Several population groups have been found to be at a greater risk of physical inactivity, including women (Bensenor, Rexrode, & Manson, 1999; Sisson & Katzmarzyk, 2008). In one of the most recent comprehensive national surveys in Australia data showed that in 1999, only 54% of women were sufficiently active as opposed to 60% of men (Armstrong, Bauman, & Davies, 2000). Similar trends have also been shown in recent data from large national surveys in US (Carlson et al., 2009). The reasons for these differences are not yet well understood. Another group that has been identified as being at greater risk of physical inactivity comprises adults of a low socio-economic position (Bauman et al., 1996; Gidlow et al., 2006). For example, in
Australia national data has shown that only 50% of adults of a low socio-economic position (as measured by education) were sufficiently active as opposed to 62% of adults of a high socio-economic position (Armstrong, Bauman, & Davies, 2000). This is of concern since the lower rate of physical activity among these groups place them at increased risk of a range of chronic health conditions. Therefore, strategies to increase physical activity amongst these target groups are important. These may include promoting physical activity across a range of domains as well as developing strategies aimed at reducing the time adults spend involved in sedentary behaviours.

### 2.1.2. Sedentary behaviour

Sedentary behaviour is distinct from physical activity and may be defined as activity that is performed at or slightly above the resting metabolic rate (1-1.5 METS) (Ainsworth et al., 2000). Like physical activity, sedentary behaviour can be categorised according to domain, and includes occupational, transport-related and leisure-time activities such as sewing, playing board games, reading, writing, driving in a car, sitting at a computer, relaxing, sitting listening to music and watching television (Hu et al., 2003; Salmon et al., 2003). In developed countries sedentary behaviour has become increasingly prevalent (AC Nielsen Company, 2000), with television viewing found to be the most common leisure-time activity amongst Australian adults (Australian Bureau of Statistics, 1998). In fact, Australian adults on average spend just over two hours per day watching television (Australian Bureau of Statistics, 1998; Salmon et al., 2000), with US data suggesting adults spend an average of three hours per day watching
television (King et al., 2010). Further, it has been found that television viewing is inversely associated with education and income (Sidney et al., 1996; Sugiyama et al., 2008b) such that socio-economically disadvantaged adults are at a greater risk of sedentary behaviour, in particular television viewing (King et al., 2010; Stamatakis et al., 2009). Sedentary behaviours, particularly television viewing, have been linked to an increased risk of several chronic health conditions, independent of physical activity, including type 2 diabetes (Dunstan et al., 2007; Owen et al., 2010), obesity (Cameron et al., 2003; Hu et al., 2003; Owen et al., 2010; Salmon et al., 2000), cardiovascular disease (Kronenberg et al., 2000; Owen et al., 2010), high blood pressure (Jakes et al., 2003; Owen et al., 2010), metabolic syndrome (Dunstan et al., 2005; Ford et al., 2005; Owen et al., 2010) and abnormal glucose metabolism (Dunstan et al., 2004; Owen et al., 2010).

Although the associations between both physical activity and sedentary behaviour and physical health have been generally well documented, increasingly research has also focused on the possible associations between physical activity (Saxena et al., 2005), sedentary behaviour (Sidney et al., 1996) and the risk of mental illness, in particular depression or depressive symptoms.

2.1.3. Depression

Depression affects more than 340 million people worldwide (Greden, 2001) and is a major cause of physical and psychosocial illness, as well as mortality (Paluska & Schwenk, 2000). In fact, depression is Australia’s most incapacitating illness (Ustun & Chetterji, 2001), with nearly 20 percent of Australian women
suffering from the disorder in their lifetime (Byles et al., 2008). Further, recent studies have found depression to be an independent risk factor for other serious diseases such as cardiovascular disease (Hollenberg, Haight, & Tager, 2003; Pratt et al., 1996).

Clinical depression is a mental disorder characterised by the existence of at least five (out of nine) symptoms from the DSM-IV major depressive symptoms list (American Psychiatric Association, 2000). These include a loss of interest/pleasure in daily activities; feelings of worthlessness or inappropriate guilt; and recurrent thoughts of death or suicide (Commonwealth Department of Health and Aged Care, 1999a). Depressive symptoms are much more common than clinical depression and also impact greatly on the health and daily living of those experiencing them (Commonwealth Department of Health and Aged Care, 1999a).

Several population groups have been found to be at a greater risk of depression than others. These include women (Wilhelm et al., 2003) and adults of a low socio-economic position (Hobfoll et al., 1995; Lorant et al., 2003). In fact, women are twice as likely to suffer from the disorder than men (Weissman & Olfson, 1995). Although management of depression has typically involved counselling/clinical treatment and/or medication (Commonwealth Department of Health and Aged Care, 1999a), the disorder is often left untreated (Hickie, 2004). The use of anti-depressant medications has become increasingly popular (Blumenthal et al., 1999); however, the possible risk of side-effects (Pollack &
Chapter 2: Literature Review (Part 1)

Smoller, 1987) and dependence (Commonwealth Department of Health and Aged Care, 1999a), as well as non-compliance (Myers & Calvert, 1984) and relapse (Craighead, Craighead, & Ilardi, 1998) reduce the effectiveness of the medication as a general treatment for depression. Due to these limitations, the importance of further research on alternative treatments is warranted. As mentioned earlier, the potential role of physical activity in the management and prevention of depression has received increasing research attention. Given the importance of physical activity for physical and potentially mental health, there is clearly a need for effective strategies to promote physical activity and reduce sedentary behaviour, particularly in target groups at risk of inactivity and sedentary behaviour, such as women and those of low socio-economic position. In order to identify such strategies, a better understanding of the correlates of physical activity and sedentary behaviours, and especially the correlates amongst these high-risk groups is required.

2.1.4. Physical activity and sedentary behaviour contexts

While physical activity and sedentary behaviour have been linked with depression (Sanchez-Villegas et al., 2008; Teychenne, Ball, & Salmon, 2008b), currently little is known about the specific physical activity or sedentary behaviour contexts which might be most important in predicting depression risk. For instance, understanding the relationship between physical activity in each domain and risk of depression is important, as such evidence can guide the development of more specifically tailored interventions. For example, if physical activity in the ‘transport’ domain is found to be associated with a substantially reduced risk of
depression in women, then interventions may promote walking or cycling to work as a means of increasing women's activity and reducing the risk of depression. Likewise, examining the association between different types of sedentary behaviour (e.g. television viewing versus sitting at the computer) and risk of depression may be important as hours spent in one sedentary behaviour (i.e. television viewing) may have a different association with risk of depression when compared to hours spent in another sedentary behaviour (i.e. sitting at the computer).

Similarly, considering the social context of physical activity is important as women of a low socio-economic position generally have less social support (from friends/family and partner) than women of high socio-economic position (Brown et al., 2001b). The social context of physical activity can be categorised as either 'accompanied' (e.g. engaging in physical activity with others) or 'individual' (e.g. engaging in physical activity by oneself). One theory proposed to explain the association between physical activity and depression is the 'social interaction hypothesis'. The social interaction hypothesis claims that improvements in mental health associated with physical activity are related at least partly to the social support and relationships that often accompany the activity (Ransford, 1982). Since social support has been previously found to be associated with higher levels of physical activity (Allen et al., 2001) and lower levels of depression (Brummett et al., 2005), it is important to investigate whether performing physical activity within a social environment has added benefits in terms of reducing the risk of depression when compared to undertaking physical activity alone. For example, if
it is found that accompanied physical activities are more strongly associated with reducing the risk of depression in women, then interventions can aim to promote group-based physical activity such as walking groups. Understanding the associations between different social contexts of physical activity and risk of depression may represent a key avenue for tailoring specific intervention messages for reducing the risk of depression in disadvantaged women.

2.1.5. The significance of this review

Recent reviews of the literature examining the relationship between physical activity and depression have generally concluded that an inverse relationship between the two variables does exist (Brosse et al., 2002; Craft & Perna, 2004; Lawlor & Hopker, 2001; Lotan, Merrick, & Carmeli, 2005; O'Neal, Dunn, & Martinsen, 2000; Paluska & Schwenk, 2000; Penedo & Dahn, 2005; Saxena et al., 2005; Teychenne, Ball, & Salmon, 2008b). Only one published review has focussed specifically on the association between physical activity and risk of depression in women (Azar, Ball, & Salmon, 2008). However, that review looked specifically at young women (aged 18-35 years). Further, only one previous review, which was conducted by the candidate (not for her PhD) has examined studies investigating the specific components (e.g. domain and social context) of physical activity and their association with risk of depression (Teychenne, Ball, & Salmon, 2008b). No reviews have considered the association between sedentary behaviours such as television viewing and risk of depression.
This literature review (Part 1) therefore is presented in two sections. **Review one** (section 2.2) examines original research which investigates the association between physical activity and risk of depression in women. Specifically, it focuses on identifying whether the balance of evidence demonstrates a relationship between physical activity and depression, as well as identifying specific domains and social contexts of physical activity most strongly associated with the risk of depression. **Review two** (section 2.3) examines the association between sedentary behaviours (e.g. television viewing and computer use) and risk of depression. Where possible, the reviews focussed on women, specifically those experiencing socio-economic disadvantage, but in many cases there were too few/no studies of this target group so where this was the case, this is noted and studies of a broader adult population are included.
2.2. Review 1: Associations between physical activity and risk of depression amongst women

2.2.1. Methodology

Search strategy
A detailed search for original research articles published post-1985 was conducted between the period of February 2008 to January 2011. Electronic databases that were utilised for the literature search included: MEDLINE (via pubmed), Psychinfo, Cinahl, Science Direct, Expanded Academic and Google Scholar. Included in the search were the following terms; physical activity, exercise, women, socio-economic status, socio-economic position, depression, mental health, domain, leisure-time, occupational, transport, domestic, social, individual, group, accompanied. Reference lists of relevant studies and reviews were further examined, as well as links to ‘related articles’ within electronic databases.

Inclusion/exclusion criteria
Both observational (i.e. cross-sectional, longitudinal) and intervention (randomised controlled trials and non-randomised controlled trials) studies are included in this literature review. Qualitative studies were included in the criteria, however none were identified. Further, abstracts, dissertations, and studies published before 1985 were excluded. This review focuses on women aged 18-60 years, as physical activity/inactivity and depression in older adults tends to be confounded by factors related to aging such as physical illness (Lian et al., 1999;
Prince et al., 1997a). Therefore, only studies including ‘healthy’ women (i.e. those not with serious underlying medical conditions that may confound statistical relationships [excluding depression]) within the age group of 18-60 years were selected for this review. Those studies may include men but results were required to be presented separately for each gender. Further, pregnant women and women who had recently given birth were also excluded from the review as those factors are likely to confound the relationship between physical activity and risk of depression (Bennett et al., 2004). Post-natal depression is recognised as quite a different entity than depression in general and since its correlates and associations with physical activity and sedentary behaviour are likely to be unique, warranting their own detailed investigation, such studies were excluded from this review and thesis.

Studies included both clinically and non-clinically depressed women. Socio-economic position was not considered in this section as no previous studies that examined the association between physical activity and depression in women of specific socio-economic positions were identified. Studies in this section were required to include a valid indicator of depression as well as at least one indicator of physical activity, including the details of the domain (i.e. leisure-time physical activity, domestic, transport-related or occupational) and/or social context (accompanied or individual) in which it was undertaken.
2.2.2. The relationship between physical activity and risk of depression in women

Observational studies
A total of 33 observational studies examining the relationship between physical activity and risk of depression in women were identified for this review (Appendix 2, Table A.2.1). Of those studies, 20 were cross-sectional, 11 were longitudinal and two combined both cross-sectional and longitudinal methodologies. Most observational studies included healthy, non-clinically depressed samples, and were predominantly from the USA, United Kingdom and Australia. Only one observational study included a sample of women with self-identified depressive symptoms (Craft et al., 2008). Risk of depression in the remaining studies was assessed using various validated measures including the Centre for Epidemiologic Studies Depression Scale (Radloff, 1977), the General Health Questionnaire (Goldberg, 1972), or the Beck Depression Inventory (Beck & Steer, 1978). Physical activity was generally assessed using well-validated questionnaires such as the Physical Activity Index (Young et al., 1995); however, several studies used less reliable measures or measures with unknown reliability (Farmer et al., 1988; Kull, 2002; Lee & Kim, 2008; Milligan et al., 1997; Weyerer, 1992). Only one study included objective measures of physical activity (i.e. pedometer) (McKercher et al., 2009).

Of the 33 observational studies, eight (five cross-sectional, three longitudinal) reported a lack of association between physical activity and risk of depression
(Asztalos, De Bourdeaudhuij, & Cardon, 2010; Bhui & Fletcher, 2000; Craft et al., 2008; Juarbe et al., 2006; Milligan et al., 1997; Oman & Oman, 2003; Rajala et al., 1994; Weyerer, 1992). However, most of those studies were potentially limited by methodological factors. For example, the lack of relationship in the longitudinal study conducted by Weyerer (1992) may be due to the use of a crude measure of physical activity, which comprised a single question that only measured participation in physical activity for sport. Moreover, Craft et al. (2008) examined only a small sample (n=61), which may have led to low statistical power.

A total of 25 studies (16 cross-sectional, nine longitudinal) found an inverse association between physical activity and depression. Findings from cross-sectional studies (Adams, Moore, & Dye, 2007; Allgower, Wardle, & Steptoe, 2001; Brown et al., 2000; France, Lee, & Powers, 2004; Galper et al., 2006; Harbour et al., 2008; Kritz-Silverstein, Barrett-Connor, & Corbeau, 2001; Kull, 2002; Lee & Kim, 2008; McKercher et al., 2009; Mutrie & Hannah, 2007; Pitsavos et al., 2005; Stephens, 1988; Steptoe et al., 1997; Taliaferro et al., 2009; Teychenne, Ball, & Salmon, 2008a) suggested that physical activity of varying intensities, i.e. light- (Mutrie & Hannah, 2007; Pitsavos et al., 2005), moderate- (Brown et al., 2000; Kull, 2002; Mutrie & Hannah, 2007; Pitsavos et al., 2005), and vigorous-intensity physical activity (Harbour et al., 2008; Kull, 2002; Mutrie & Hannah, 2007; Pitsavos et al., 2005), were all inversely associated with risk of depression. Physical activity of both small doses (e.g. one exercise session per week (Kull, 2002)) and large doses (e.g. being physically active for 30 minutes,
five days per week (Brown et al., 2000)) was seen to be related to lower risk of
depression. Brown et al (2000) found that adhering to the national physical
activity recommendations of performing 30 minutes of moderate-intensity
physical activity on most, if not all, days of the week (Commonwealth
Department of Health and Aged Care, 1999b), provided the greatest benefit to
mental health in comparison with lesser amounts.

Of the 25 observational studies that reported a significant association between
physical activity and depression, nine were longitudinal in design (Ball, Burton,
& Brown, 2009; Brown et al., 2005a; Camacho et al., 1991; Carroll et al., 2010;
De Moor et al., 2008; Farmer et al., 1988; Mikkelsen et al., 2010; Wise et al.,
2006; Wyshak, 2001). The longitudinal design of those studies helps determine
the direction of causation, and therefore can help elucidate whether the inverse
relationship between physical activity and depression is due to the beneficial
effect of physical activity on reducing depressive symptoms, or the fact that
subjects with depressive symptoms are more likely to be physically inactive.

For example, in the longitudinal study conducted by Brown et al. (2005a)
comprising of 39,532 middle-aged Australian women, it was found that women
who were in the lowest physical activity category at baseline but who were
meeting the physical activity recommendations at follow-up (five years later)
were less likely to be at risk of depression after five years (according to the Centre
for Epidemiologic Studies Depression Scale) when compared to those who did
not increase their physical activity throughout the study. Similarly, Camacho et al
(1991) found that women who reported low activity at baseline were at a greater risk of depression at follow-up (nine years later) than those who reported high activity levels at baseline. Another longitudinal study (Farmer et al., 1988), which used the Centre for Epidemiologic Studies Depression Scale as a measure of depression, reported a similar trend from their sample of 1,900 healthy adults. Farmer et al. (1988) revealed that even after excluding those with depressive symptoms at baseline, physical activity was a significant predictor of depression in white women, approximately eight years later. That was despite the fact that that study used a measure of physical activity which had not been validated and failed to take into account the type, duration, or frequency of physical activity when assessing the relationship (Farmer et al., 1988).

Alternatively, one longitudinal study (De Moor et al., 2008) suggested that the inverse association between physical activity and depressive symptoms was not explained by a causal hypothesis, but rather by common genetic factors such as a common genetic vulnerability to lack of exercise and risk of depressive symptoms. That study included a genetically informative sample of identical twins and their families. Since that study is the only longitudinal study to date to test the causal effect of physical activity on depressive symptoms using a genetically informative design, it highlights a need for further research examining the potential genetic mechanisms for the association between physical activity and depressive symptoms.
Two longitudinal studies (Wise et al., 2006; Wyshak, 2001) found that women who were active in high school or college had significantly less depressive symptoms in middle-life/adulthood when compared to women who were inactive during that period. However, Wyshak et al. (2001) acknowledged the fact that women in their study were all highly educated and motivated (college alumni) and this may have confounded the relationship between physical activity and depression, as it has been found that physical activity and education are positively associated (Yeager, Macera, & Merritt, 1993). A more representative sample of women from various levels of socio-economic position would be more appropriate in order to generalise results to a wider population.

Similar to the cross-sectional studies mentioned earlier, findings from these longitudinal studies suggested that both low doses [e.g. one hour per week (Brown et al., 2005a)] and higher doses [e.g. greater than five hours per week (Wise et al., 2006)] of physical activity were associated with a reduced risk of depression. Further, most longitudinal studies found that light (Camacho et al., 1991), moderate (Brown et al., 2005a) and vigorous-intensity physical activity (Carroll et al., 2010; Wise et al., 2006) were associated with a reduced risk of depression. However, Wise et al. (2006) found that only vigorous-intensity physical activity was associated with reduced risk of depression, with no association seen with walking (light-intensity). That study included a sample of Black women and therefore generalisability of results to other racial groups is unknown.
Given that 25 of the 33 observational studies did present evidence of a relationship, the studies in this review provide reasonably strong support for the hypothesis that physical activity is inversely associated with depression. Further, evidence from longitudinal studies suggests that physical activity may precede the reduced risk of depression in women. However, the possibility of reverse causality cannot be disregarded on the basis of observational findings. For example, those at risk of depression may have an increased likelihood of being inactive, as a consequence of their depression. Intervention studies can help to rule out this hypothesis.

**Intervention studies**

A total of 18 intervention studies were identified in this review (Appendix 2, Table A.2.2). All of those studies were randomised controlled trials. Intervention studies included both healthy (non-clinically depressed) and clinically depressed samples, and were predominantly conducted in the US. Risk of depression was assessed using various validated measures including the Centre for Epidemiologic Studies Depression Scale (Radloff, 1977), Hamilton Rating Scale for Depression (Hedlung & Vieweg, 1979), Profile of Mood States (McNair, Lorr, & Droppleman, 1971) and the Beck Depression Inventory (Beck & Steer, 1978).

Of the 18 intervention studies, five reported no effect of physical activity on depressive symptoms (King et al., 1989; Lee et al., 2001; Nieman et al., 2000; Norvell, Martin, & Salamon, 1991; Palmer, 1995). The lack of association may be explained by the fact that all five of those randomized controlled trials
included non-depressed women in their samples, leaving little room for improvement in depressive symptoms. Of the 13 intervention studies that did find a relationship between physical activity and depression, three studies included women with clinical depression (Doyne et al., 1987; Pilu et al., 2007; Pinchasov et al., 2000), three studies included samples of women with mild-moderate depressive symptoms (Brown et al., 2001a; Craft et al., 2007; Nabkasorn et al., 2005), and seven studies included ‘healthy’ women (Anderson et al., 1999; Asbury, Chandruuangphen, & Collins, 2006; Balkin et al., 2007; Berger & Owen, 1992; Brown et al., 1995; Cramer, Nieman, & Lee, 1991; King, Taylor, & Haskell, 1993).

Of the studies that included women with clinical depression, Pinchasov et al. (2000) assessed the effectiveness of physical activity versus bright light therapy in a one-week randomised controlled trial involving 63 women with either winter depression, non-seasonal depression, or no depressive symptoms. Women in the physical activity group were prescribed a daily exercise routine consisting of 1-hour of daily cycling, performed at a moderate-vigorous intensity, whilst women in the bright light therapy group were exposed to bright light (2500 lux cool-white incandescent light) for 2-hours daily, for one-week. Results showed that both physical activity and bright light therapy were effective in alleviating depressive symptoms in women with winter depression, whilst exercise was an effective treatment in women with non-seasonal depression. The study suggested that the beneficial effects of physical activity on reducing depression can be seen after just one week of moderate-vigorous intensity exercise. However, as depressive
symptoms were only tested at the conclusion of the intervention and not beyond, it is unable to be determined whether the effects of physical activity on risk of depression can be maintained beyond such as short period, highlighting the need for further intervention studies with more extended follow-up periods.

Doyne et al. (1987) also assessed the effectiveness of an exercise intervention in the treatment of women with clinical depression. Participants were assigned to either a walking/running group, a weight-lifting group, or a wait-list control group. Participants were to attend four sessions per week for eight weeks. Results showed that both aerobic exercise (running/walking) and anaerobic exercise (weight-lifting) were effective in reducing depressive symptoms in women with clinical depression. The study also suggested that increasing cardiovascular fitness was not necessary for improvements in depression, emphasising the importance of other aspects of physical activity such as socialisation and enjoyment for improved mental health. However, a limitation of that study was the relatively high drop-out rate seen amongst participants (running [40%], weight-lifting [29%], and control group [13%]). This highlights the need for increasing adherence rates to physical activity in further intervention studies aimed at reducing depressive symptoms among the clinically depressed.

Pilu et al. (2007) assessed the effectiveness of a physical activity and pharmacology treatment intervention in reducing depressive symptoms by comparing results of that intervention group to controls receiving pharmacology treatment only. The study found that participants in the intervention group had
reduced depressive symptoms eight months after beginning the program. In contrast, the control group (receiving pharmacology treatment only) did not reduce their depressive symptoms significantly.

All three intervention studies that included women with mild-moderate depressive symptoms (Brown et al., 2001a; Craft et al., 2007; Nabkasorn et al., 2005) included moderate-intensity physical activity programs aimed at alleviating depressive symptoms. Brown et al. (2001a) and Craft et al. (2007) included relatively low doses of physical activity (e.g. 1.5 hours per week), whilst Nabkasorn et al. (2005) included a greater dose (e.g. >4 hours per week). Although those studies concluded that physical activity had a beneficial effect on reducing the risk of depression, limitations were evident. Brown et al. (2001a) assessed the effectiveness of an 8-week intervention which included an aerobic exercise program, instructions to increase/maintain light exposure and daily vitamin consumption (which included vitamin D). As physical activity was undertaken in conjunction with other methods which have been linked to reducing depression (i.e. light exposure (Espiritu et al., 1994) and vitamin intake (Lansdowne & Provost, 1998)), it cannot be determined whether physical activity alone produced the beneficial effects of reducing depressive symptoms in that study. Further, Craft et al. (2007) utilised two exercise intervention groups (with the home-based exercise intervention group serving as a control) and did not include a non-exercising control group in their study.
Since depressive symptoms are common in society, intervention studies assessing the effect of physical activity on risk of depression in non-depressed samples are also important. Seven intervention studies that included ‘healthy’ non-depressed women found a significant inverse association between physical activity and depressive symptoms (Anderson et al., 1999; Asbury, Chandruangphen, & Collins, 2006; Balkin et al., 2007; Berger & Owen, 1992; Brown et al., 1995; Cramer, Nieman, & Lee, 1991; King, Taylor, & Haskell, 1993). Those studies found that both moderate- (Asbury, Chandruangphen, & Collins, 2006; Berger & Owen, 1992; Brown et al., 1995; Cramer, Nieman, & Lee, 1991) and vigorous-intensity physical activity interventions (Anderson et al., 1999; Balkin et al., 2007; King, Taylor, & Haskell, 1993) were associated with a reduced risk of depression. Further, doses of physical activity ranging from 1-hour per week (Berger & Owen, 1992) to 3-hours per week (King, Taylor, & Haskell, 1993) were effective in reducing depressive symptoms.

Since 13 out of 18 intervention studies showed a significant association between increasing physical activity and decreasing depressive symptoms, this review suggests that the balance of intervention evidence is supportive of a relationship between physical activity and reduced risk of depression, highlighting the potential of physical activity as a treatment for reducing depressive symptoms.

**Summary**

While not completely unequivocal, both the observational (Appendix 2, Table A.2.1) and intervention studies (Appendix 2, Table A.2.2) reviewed here provide
relatively strong evidence that physical activity is associated with reduced risk of depression in women. Further, the intervention studies suggest a causal pathway in which physical activity may have an effect on reducing depressive symptoms. Despite a number of studies having methodological limitations (e.g. small sample sizes and physical activity measures of unknown psychometric properties), evidence was on balance reasonably consistent in supporting a relationship. Until recently, another gap in the literature was understanding the optimal dose (i.e. intensity, frequency, duration) of physical activity for reducing the risk of depression (Dunn, Trivedi, & O'Neal, 2001). However, this aspect has been previously reported by the candidate in a review completed during fourth year Honours (Teychenne, Ball, & Salmon, 2008b) which we concluded that even small doses of physical activity (e.g. low intensity or short duration) were associated with a reduced risk of depressive symptoms.

Further research is needed to better understand the association between physical activity and depression in women, in particular the specific components of physical activity that may play a role in this association. For example, understanding the domain of physical activity (i.e. leisure-time, domestic, work- and transport-related physical activity), as well as the social context (accompanyed versus individual physical activity) most strongly associated with reducing depressive symptoms will enable the development of specific physical activity recommendations for reducing the risk of depression in women. We examined the association between various domains of physical activity and risk of depression in a previous review of adults (Teychenne, Ball, & Salmon, 2008b), but that review
focussed on both men and women. An overview of this evidence relevant to women only is presented below.

### 2.2.3. Associations between the domain of physical activity and risk of depression in women

Although a number of studies have examined the relationship between leisure-time physical activity and risk of depression in women, little is known about the association between physical activity undertaken in other domains (i.e. domestic, work- and transport-related physical activity) and risk of depression in women. Understanding the association between different domains of physical activity and risk of depression in women is important, as women have been found to be most physically active in domains other than leisure-time (e.g. domestic) (Ainsworth et al., 1993) and therefore may be able to gain benefits without needing to engage in additional physical activity beyond their current daily activities. The following section describes previous research examining the association between different domains of physical activity and risk of depression in women.

**Observational studies**

A total of 16 of the 33 observational studies described in Table A.2.1 assessed the relationship specifically between leisure-time physical activity and risk of depression in women (Adams, Moore, & Dye, 2007; Allgower, Wardle, & Steptoe, 2001; Brown et al., 2005a; Craft et al., 2008; De Moor et al., 2008; Farmer et al., 1988; France, Lee, & Powers, 2004; Galper et al., 2006; Juarbe et al., 2006; Lee & Kim, 2008; Oman & Oman, 2003; Pitsavos et al., 2005;
Taliaferro et al., 2009; Weyerer, 1992; Wise et al., 2006; Wyshak, 2001), with only four of those studies not revealing a statistical relationship between the two variables (Craft et al., 2008; Juarbe et al., 2006; Oman & Oman, 2003; Weyerer, 1992). Although Weyerer et al. (1992) did find an inverse association between leisure-time physical activity and depression in cross-sectional analyses, the longitudinal data showed a non-significant association. However, that study only assessed physical activity in terms of ‘sports participation’. Therefore, it is limited in aiding our understanding of associations between other types of leisure-time physical activity and risk of depression, particularly as walking has been found to be the most popular form of physical activity for women (Australian Bureau of Statistics, 2006a).

A total of 11 observational studies described in Table A.2.1 included physical activity in domains other than leisure-time (Ball, Burton, & Brown, 2009; Bhui & Fletcher, 2000; Brown et al., 2000; Camacho et al., 1991; Carroll et al., 2010; McKercher et al., 2009; Mikkelsen et al., 2010; Mutrie & Hannah, 2007; Rajala et al., 1994; Stephens, 1988; Teychenne, Ball, & Salmon, 2008a). Four of those studies combined ‘leisure-time and domestic physical activity’ domains to examine the relationship with risk of depression (Bhui & Fletcher, 2000; Brown et al., 2000; Camacho et al., 1991; Stephens, 1988), with only one of the four not finding an association between the two variables (Bhui & Fletcher, 2000). Respondents in that longitudinal study, however, included adults who were ‘healthier’ than the general population, with authors suggesting that this factor may have influenced the impact of exercise in the study. This may due to a
“ceiling effect” by which respondents reported too few depressive symptoms to detect an association with physical activity.

The three studies that did find an association between the combined measure of ‘leisure-time and domestic’ physical activity and risk of depression (Brown et al., 2000; Camacho et al., 1991; Stephens, 1988) used various methods to assess physical activity and depression. For example, the cross-sectional study conducted by Stephens et al. (1988) used the CES-D as a measure of depression, whilst the cross-sectional study conducted by Brown et al. (2000) utilised the SF-36-Medical outcomes study’s functioning and well-being profile. In the longitudinal study by Camacho et al. (1991), a validated but non-specified measure of depression was used. Although using different measures makes results difficult to compare, the fact that all three studies found an association between the combined leisure-time/domestic physical activity measure and depression emphasises the robustness of this association.

Three studies assessed the relationship between a combined measure of leisure-time and transport physical activity and risk of depression in women (Ball, Burton, & Brown, 2009; Mikkelsen et al., 2010; Rajala et al., 1994). Although the two longitudinal studies found an inverse association (Ball, Burton, & Brown, 2009; Mikkelsen et al., 2010), the cross-sectional study by Rajala et al. (1994) found no association between the variables. However, the physical activity measure used in that study was based on a single self-report question which did not appear to be validated. Using a combined measure of physical activity
domains may reduce the ability to determine whether some domains are more strongly associated with reducing the risk of depression than others.

Only three observational studies specifically compared the association between physical activity in various domains and risk of depression in women (McKercher et al., 2009; Mutrie & Hannah, 2007; Teychenne, Ball, & Salmon, 2008a). Those studies included measures of domestic, work-related, leisure-time, and overall physical activity. Further, Teychenne et al. (2008a) and McKercher et al. (2009) also included a measure of transport-related physical activity. All three studies found that leisure-time physical activity was inversely associated with risk of depression (McKercher et al., 2009; Mutrie & Hannah, 2007; Teychenne, Ball, & Salmon, 2008a). Further, Mutrie et al. (2007) found an association in the opposite direction between domestic (household) physical activity and risk of depression, as depression scores were higher with increased levels of domestic physical activity. This positive relationship may be due to a higher proportion of time spent doing housework being associated with fewer opportunities for women to participate in physical activities that they enjoy (Mutrie & Hannah, 2007). Conversely, Teychenne et al. (2008a) and McKercher at al. (2009) found no association between domestic physical activity and risk of depression in their samples. Unlike Mutrie et al. (2007), those studies utilised categorical depression scores rather than continuous depression scores which may have reduced the sensitivity of results.
McKercher et al. (2009) found a positive association between work-related physical activity and risk of depression, suggesting that high durations of work-related physical activity (>10 hours per week) increased the prevalence of depression twofold. However, that study also found an inverse association between total weekly physical activity (measured by number of steps using a pedometer) and risk of depression. These opposite findings may be explained by the impact that the inclusion of leisure-time physical activity has within the total weekly measure. In contrast, no associations between work-related or total physical activity and risk of depression in women were found in studies by Teychenne et al. (2008a) or Mutrie et al. (2007). Furthermore, no relationship was found between transport-related physical activity and risk of depression in the studies conducted by Teychenne et al. (2008a) and McKercher et al. (2009).

**Summary**

In summary, most observational studies indicated that leisure-time physical activity was inversely associated with risk of depression amongst women. However, the limited and conflicting evidence examining the relationship between other domains of physical activity (i.e. domestic, work-, transport-related) and risk of depression suggests the need for further observational studies assessing these associations.

**Intervention studies**

All of the 18 intervention studies described in Table A.2.2 assessed the effects of leisure-time physical activity interventions on the risk of depression in women,
with most finding an inverse association between leisure-time physical activity and depressive symptoms. However, only one of those studies compared physical activity undertaken in different domains (Anderson et al., 1999). That randomised controlled trial included two intervention groups: a structured aerobic exercise group (i.e. leisure-time physical activity), and a moderate-intensity lifestyle activity group (i.e. domestic, transport- and work-related physical activity). Both interventions were associated with a reduction in depressive symptoms, with no differences found between the two groups. However, it should be noted that both interventions also included a low-fat diet, which may have confounded intervention effects. For example, it has been found in previous studies that low vitamin B₁₂ (Sanchez-Villegas et al., 2006) and omega-3 fatty acid (Timonen et al., 2004) intakes (found in fish) were associated with increased risk of depression in women. Therefore, in the study by Anderson et al. (1999) the prescribed diet in conjunction with physical activity may have conferred added mental health benefits. No further intervention studies have examined the association between domestic, work- and transport-related physical activity and risk of depression in women.

Summary

Although numerous observational and intervention studies have examined the association between leisure-time physical activity and risk of depression in women, very few studies have considered physical activity from other domains (e.g. domestic, work- and transport-related). From the studies presented in Tables A.2.1 and A.2.2, it can be generally inferred that leisure-time physical activity is
inversely related to risk of depression in women. However, further observational and intervention studies are needed in order to better understand the association between domestic, work- and transport-related physical activity and risk of depression in women. Moreover, since no previous studies have assessed the association between physical activity and risk of depression amongst socio-economically disadvantaged women, further studies are needed particularly within this target group.

2.2.4. The association between the social context of physical activity and risk of depression in women

The association between physical activity undertaken in different social contexts and risk of depression has received very little research attention. However, it is important to understand what types of activities, in what social context (e.g. physical activity undertaken with company, such as an aerobics class; with one other person, such as walking with a friend; or alone/individually) are most strongly associated with women’s risk of depression. The following section reviews evidence from previous studies that have assessed the social context of physical activity and depression in women.

Observational studies

To date, only one observational study which the Candidate conducted has examined the social context of physical activity and its association with risk of depression in women (Teychenne, Ball, & Salmon, 2008a). In that study, we used several measures of social support and social context of physical activity
when examining the relationship with risk of depression. It was found that being active with a family member was associated with lower odds of depression. However, no association was seen between being active with a friend and risk of depression, suggesting that family support for physical activity may be more important in protecting against depression than support from friends (Teychenne, Ball, & Salmon, 2008a). However, as that was a cross-sectional study, the temporal association between physical activity and risk of depression is unclear. No associations were seen between having no one to exercise with, having someone to walk with, or being a member of a sporting club and risk of depression. However, being discouraged from physical activity was associated with higher odds of depression which suggests that having an unsupportive social network may be a significant factor within the relationship between physical activity and depression. In that study, however, physical activity was assessed using the International Physical Activity Questionnaire (IPAQ-L), which did does not directly assess the social context of participants’ reported weekly physical activity. Therefore further studies using more direct measures of social context (e.g. comparing the number of hours spent in activity alone with hours in activity with someone else/in a group) are needed.

Two cross-sectional studies described in Table A.2.1 did include a measure of social support specifically when assessing the relationship between physical activity and risk of depression (Craft et al., 2008; Steptoe et al., 1997). Steptoe et al. (1997) found that greater social support (e.g. the number of people that could be called upon to support the participant in a range of situations) in general was
associated with both higher levels of physical activity, as well as lower risk of depression amongst women. That study, however, included a much broader measure of social support (i.e. not specific to physical activity) than that of other studies. In contrast, Craft et al. (2008) found no association between family or friend social support for physical activity and depressive symptoms. Although that study included more specific measures of social support for physical activity (e.g. how often a friend offered to exercise with them), the study involved a small sample (n = 61), which may have limited the power to detect significant results.

Summary

In brief, only one observational study has examined the association between the social context of physical activity and risk of depression in women (Teychenne, Ball, & Salmon, 2008a). Additionally, two observational studies (Craft et al., 2008; Steptoe et al., 1997) examined social support for physical activity (which is distinct from the social context), highlighting the need for further studies assessing the association between the social context of physical activity and risk of depression in women.

Intervention studies

Of the 18 intervention studies summarised in Table A.2.2 (Appendix 2), a total of 13 studies explicitly defined the social context of physical activity undertaken by participants in intervention groups (Anderson et al., 1999; Balkin et al., 2007; Berger & Owen, 1992; Brown et al., 1995; Brown et al., 2001a; Craft et al., 2007; Cramer, Nieman, & Lee, 1991; Doyne et al., 1987; King, Taylor, & Haskell,
Eight studies included interventions that examined the effect of ‘accompanied physical activity’ on women’s depressive symptoms (Anderson et al., 1999; Balkin et al., 2007; Berger & Owen, 1992; Brown et al., 1995; Cramer, Nieman, & Lee, 1991; Nabkasorn et al., 2005; Palmer, 1995; Pilu et al., 2007) with all but one (Palmer, 1995) of those studies finding a significant relationship. Although all seven studies that found ‘accompanied physical activity’ to reduce risk of depression were randomised controlled trials, their intervention formats differed greatly. For example, Anderson et al. (1999) included group aerobics classes, whilst Berger et al. (1992) included swimming and yoga. A walking group was used by participants in the study by Cramer et al. (1991), and group jogging sessions were conducted by Nabkasorn et al. (2005). Brown et al. (1995) included group Tai-chi classes and Pilu et al. (2007) included group strength training classes.

Balkin et al. (2007) included an aerobic exercise group as well as an anaerobic (weight-lifting) exercise group. That study found that depressive symptoms were reduced in women participating in the aerobic exercise group; however, women in the weight-lifting group saw no change in depressive symptoms at the end of the intervention. Findings from that study suggest that the type of exercise, rather than the social context, may be important for conferring mental health benefits. On balance, however, the intervention studies discussed above show that a range of physical activities undertaken in a social setting may be effective in reducing the risk of depression. However, since the studies described were not designed to
compare the effects of accompanied physical activity versus solitary physical activity, the optimal social context of physical activity for reducing the risk of depression is unable to be determined.

Three intervention studies specifically examined the effect of *individual* physical activity on depressive symptoms (Brown et al., 2001a; Doyne et al., 1987; King et al., 1989). Doyne et al. (1987) included both an individual weight-lifting (anaerobic) intervention group and an individual running (aerobic) intervention group, whilst King et al. (1989) and Brown et al. (2001a) included home-based brisk-walking programs. All three randomised controlled trials found the individual physical activity interventions to be successful in reducing depressive symptoms in women. However, as previously reported, Brown et al. (2001a) included a tri-modal intervention that included a combination of increased exercise, sunlight and vitamin intake. Further, Brown et al. (2001a) included brief coaching/counselling sessions with a member of the research team by telephone every two weeks. This extra social support provided may have had an additional effect on reducing participant’s risk of depression, as social support in general (e.g. reassurance of worth from others) has been found to be inversely associated with depression (Hawkins et al., 1999). However, as the three studies described did not compare the effects of accompanied versus solitary physical activity, the optimal social context of physical activity for reducing depressive symptoms cannot be determined.
Only two intervention studies have compared the effects of differing social contexts of physical activity on depressive symptoms in women (Craft et al., 2007; King, Taylor, & Haskell, 1993). Both interventions compared individual (home-based) physical activity programs with group-based (accompanied) activity programs and found significant effects of both formats in reducing participant’s depressive symptoms. No differences were seen between intervention groups (individual versus accompanied physical activity) in either study, suggesting that the social context of the physical activity was not the crucial factor in the relationship between physical activity and depression. It should be noted that the study conducted by King et al (1993) reported contrasting results for the two different measures of depression. That study found significant inverse associations between both social contexts of physical activity and depression using the Rating of Perceived Change (RPC; an indicator of participants’ own perceptions of their mental health). However, no associations were found between either social context of physical activity and risk of depression when using the Beck Depression Inventory (BDI; a validated screening tool for depression) as a measure of depressive symptoms.

**Summary**

The social context of physical activity may be an important component in influencing the association between physical activity and depression in women. The very limited evidence available suggests that both individual and accompanied physical activity may be inversely associated with risk of depression in women. However, it is difficult to conclude an optimal social format for
reducing the risk of depression, since very little research has examined this relationship. Further studies are required in order to assess the relationship between the social context of physical activity and risk of depression, particularly in women.

In this review, no studies were identified that have assessed the associations between physical activity domain or social context and risk of depression in socio-economically disadvantaged women. As socio-economically disadvantaged women are a higher risk of depression (Hobfoll et al., 1995; Scarinci et al., 2002) and of physical inactivity (Armstrong, Bauman, & Davies, 2000; Bauman et al., 1996), this highlights an important gap in research on reducing the risk of depression.

Another understudied area of research related to reducing the risk of depression concerns the association between sedentary behaviour and depression. Sedentary behaviour has become increasingly prevalent in developed societies (DiNardo & Pischke, 1997), and linked to an increased risk of several chronic health conditions (Cameron et al., 2003; Dunstan et al., 2007; Dunstan et al., 2004; Hu et al., 2003; Kronenberg et al., 2000). Since sedentary behaviour and physical activity are quite distinct, it is important to investigate whether specific sedentary behaviours are related to risk of depression.
2.3. Review 2: Associations between sedentary behaviour and risk of depression amongst adults

2.3.1. Methodology

Search strategy
A systematic search for original research articles published post-1985 was conducted between the period of February 2008 to January 2011, as sedentary behaviour, in particular computer use, was found to increase significantly in developed countries after 1985 (DiNardo & Pischke, 1997). Electronic databases that were utilised for the literature search included: MEDLINE (via pubmed), Cinahl, Psychinfo, Science Direct, Google Scholar and Expanded Academic. Included in the search were the following terms; physical activity, sedentary behaviour(s), TV/television viewing, sitting time, computer use, inactivity, women, socio-economic status, socio-economic position, depression, mental health. Reference lists of relevant studies and reviews were further examined, as well as links to ‘related articles’ within electronic databases.

Inclusion/exclusion criteria
Both observational (i.e. cross-sectional, longitudinal) and intervention (randomised controlled trials and non-randomised controlled trials) studies are included in this literature review. Qualitative studies were included in the criteria, however none were identified. Further, abstracts, dissertations, and studies published before 1985 were excluded. Since so few studies focussed on the relationship between sedentary behaviour and depression specifically in women,
studies of ‘healthy’ adults (aged 18-60) of both genders were included in this review (i.e. those without serious underlying medical conditions that may confound statistical relationships [excluding depression]).

Socio-economic position was not considered in this section as the literature review identified that no previous studies examined the association between sedentary behaviour and depression in adults of specific socio-economic positions. Studies in this section were required to include a valid indicator of depression as well as at least one measure or indicator of sedentary behaviour (i.e. any measure that assessed participants’ engagement in television viewing, computer and/or internet use or overall sitting time).

2.3.2. The relationship between sedentary behaviour and depression in adults

A total of 17 studies assessing the relationship between sedentary behaviour and risk of depression were identified for this review (Appendix 2, Tables A.2.3 and A.2.4), with one paper (Kraut et al., 2002) presenting two separate studies within it. Of the 17 studies, 13 were observational (nine cross-sectional, four longitudinal) and four were intervention studies. Participants in the studies were ‘healthy’ non-clinically depressed adults, predominately from the US. Risk of depression was assessed using measures such as the Beck Depression Inventory and the Centre for Epidemiologic Studies Depression Scale. Sedentary behaviour was measured using various methods. For example, television viewing was measured using time use logs (Dittmar, 1994) and questionnaires (de Wit et al., 2010b; King et al., 2010; Kleinke, 1988; Sidney et al., 1996); computer/internet use.
use was measured using computer software (Kraut et al., 2002; Kraut et al., 1998) and questionnaires (Bessiere et al., 2008; Bessiere et al., 2010; Morgan & Cotten, 2003; Morrison & Gore, 2010; Thomee et al., 2007); overall sedentary behaviour (i.e. sitting and lying time) was measured using a ‘Sedentary Index’ (Sanchez-Villegas et al., 2008), as well as by objective measures such as accelerometers (Sanchez et al., 2008). These measures are described in further detail in Tables A.2.3 and A.2.4 (Appendix 2). Only two studies reported on the validity and reliability of the measures used to assess sedentary behaviour (Hamer, Stamatakis, & Mishra, 2010; Sanchez et al., 2008).

Of the 17 studies, 11 (10 observational and one intervention) found a positive association between sedentary behaviours and risk of depression (de Wit et al., 2010b; Dittmar, 1994; Hamer, Stamatakis, & Mishra, 2010; King et al., 2010; Kleinke, 1988; Kraut et al., 1998; Morrison & Gore, 2010; Sanchez-Villegas et al., 2008; Sanchez et al., 2008; Sidney et al., 1996; Thomee et al., 2007). That is, these studies found that greater time spent in sedentary behaviour was associated with higher odds of depressive symptoms. Two intervention studies found an inverse association between sedentary behaviour and risk of depression (i.e. the greater time spent in sedentary behaviour, the lower the odds of depressive symptoms) (Kraut et al., 2002; Shaw & Gant, 2002). One cross-sectional (Morgan & Cotten, 2003) and two longitudinal (Bessiere et al., 2008; Bessiere et al., 2010) studies found both positive and negative associations between sedentary behaviour and risk of depression (depending on the purpose of engaging in the sedentary behaviour), whilst one intervention study found no association between
the two variables (Kraut et al., 2002). The following section provides a discussion of the findings of those studies according to the type of sedentary behaviour examined.

**Overall sedentary time**

One cross-sectional study assessed the relationship between ‘overall’ sedentary time (eg. time spent sitting and lying) and risk of depression (Sanchez et al., 2008). Sanchez et al. (2008) used accelerometers to measure time spent sedentary in 394 overweight/obese women. Daily hours of sedentary time were defined by summing the minutes spent at less than 100 counts per minute for valid hours of monitoring (i.e. when awake). The study found that those who reported greater amounts of overall sedentary time had higher odds of depressive symptoms.

**Combined television viewing and computer use**

One cross-sectional (Hamer, Stamatakis, & Mishra, 2010) and one longitudinal (Sanchez-Villegas et al., 2008) study examined the relationship between combined self-reported television viewing and computer use and risk of depression. Hamer et al. (2010) found that adults reporting greater than four hours of leisure-time television and screen-based entertainment per day were at a greater risk of depression compared to those reporting less than two hours per day. This was significant even after adjusting for physical activity level and physical function. The authors did not differentiate between types of screen-based activity. However, since the survey was conducted in 2003, it may be assumed that high speed internet access was not readily available in Scotland and therefore most of
the screen-based entertainment time reported was most likely related to television viewing.

Similarly, the longitudinal study by Sanchez-Villegas et al. (2008) found that participants with the highest levels of sedentary habits (as measured by a self-report questionnaire assessing weekly television viewing/computer use) at baseline (>42 hours per week) were 31% more likely to be at risk of a mental disorder (depression, bipolar, anxiety or stress) at follow-up than those who reported low levels of sedentary behaviour at baseline (<10 hours per week). One limitation of that study is that depression was not reported exclusively as the outcome measure (e.g. the outcome measure [mental disorder] also included bipolar disorder, stress and anxiety). Interestingly, that study reported an interaction between sedentary behaviour, physical activity and risk of a mental disorder. It showed that if physical activity was below the median (<13.8 MET.h.wk⁻¹), engaging in sedentary behaviour was associated with an increased risk of a mental disorder. However, when physical activity was above the median, sedentary behaviour was not as strongly associated with risk of a mental disorder, suggesting some attenuation of the relationship between sedentary behaviour and risk of a mental health disorder for those who are more physically active. As no other previous studies have assessed such a relationship, this highlights an important point of consideration and area for further research. It may be that having a low sedentary lifestyle plays an important role in reducing the risk of depression only when physical activity levels are also low.
**Television viewing**

Five cross-sectional studies assessed the relationship between self-reported television viewing and depression. Four of those studies (de Wit et al., 2010b; Dittmar, 1994; King et al., 2010; Sidney et al., 1996) used measures which assessed the hours spent watching television, whilst Kleinke et al. (1988) included one question only determining whether the participant watches television (yes/no). Although this sedentary behaviour measure used by Kleinke et al. (1988) is somewhat crude and potentially insensitive, all five studies including this one, found that television viewing was positively associated with risk of depression. Since television viewing has been found to be ranked only behind sleep and work in the amount of time spend by people (Comstock et al., 1978), findings from this review emphasise the importance of reducing television viewing not only for improving physical health, but also for improving mental health. However, findings from the five studies identified should be interpreted with caution as their cross-sectional design does not allow for causality to be determined. It is therefore not established whether television viewing increases the risk of depression, or whether those with depressive symptoms tend to engage in more television viewing as a consequence of their depression than those without.

**Internet/computer use**

Although 10 (3 cross-sectional, 3 longitudinal, 4 intervention) studies have assessed the association between internet/computer use and depression, findings are mixed. Morrison et al. (2010) assessed the association between internet use
and depression, measuring the proportion of time spent on the internet for various purposes including games use, chatting, e-mail, research and shopping, gambling, and visiting community and sexually gratifying sites. That study found that using the internet for games, chat, browsing, visiting community and sexually gratifying sites were positively associated with depressive symptoms. However, using the internet for e-mail, research, gambling and shopping was not associated with depressive symptoms.

Similarly, Thomee et al. (2007) assessed prospective associations between the individual components of information and communications technology (including time spent using computers, surfing the internet, chatting online, and e-mailing) and risk of depression. That study found that time spent e-mailing and chatting online predicted increased risk of depression at the one-year follow-up in women (but not in men). However, no relationship was found between overall computer or internet use and risk of depression. The difference in findings may be explained by the fact that women using the computer for e-mailing and chatting may have been more inclined to engage in this sedentary behaviour during leisure-time, whilst overall computer and internet use may have included more work-related sedentary behaviour. As the questionnaire used to assess time spent engaged in information and communication technology (ICT) did not differentiate between domains of the sedentary behaviour, this limits the interpretation of results.
The only cross-sectional study that assessed overall computer use and risk of depression found a positive relationship between time spent using the computer and depression (more specifically dysthymia) (de Wit et al., 2010b). Similarly, of the four intervention studies identified, one experimental study conducted by Kraut et al. (1998) which assessed the relationship between hours spent using the internet (using internet usage software) and risk of depression in a sample of families found that overall internet use was associated with an increased risk of depression.

Two of the four intervention studies identified in this review found a negative association between computer/internet use and risk of depression (Kraut et al., 2002; Shaw & Gant, 2002), reporting that greater time spent using the computer/internet was related to lower odds of depression. Kraut et al. (2002) conducted an intervention study which assessed the relationship between internet use and depression in a sample of families who were provided with a computer and free internet access. They found that depressive symptoms increased within the first period of assessment, then over time significantly decreased with internet/computer use, implying that time spent on the internet may actually be beneficial in reducing the risk of depression over time. However, that study only assessed the number of hours on the internet and did not take into account the type of internet activities participants were undertaking. For example, if participants were ‘chatting’ online or writing e-mails to friends, it may be the social interaction that was accountable for the reduction in depressive symptoms.
A randomised trial conducted by Shaw et al. (2002) assessed the effects of an internet ‘chatting’ intervention, which prescribed five ‘chat’ sessions between participants, on risk of depression. That study found that internet ‘chatting’ led to a reduction in depressive symptoms. Furthermore, the study found that internet use reduced loneliness and increased social support, suggesting a potential underlying mechanism in the relationship between internet use and depression. Therefore, it may be the purpose of engaging in specific sedentary behaviours, rather than the time spent undertaking them, that has the greatest impact on the risk of depression. For example, had the intervention involved surfing the internet for educational or work-related purposes, results may have been different.

Further, three observational studies that assessed the association between internet use for various purposes and risk of depression found both positive and negative associations between internet use and risk of depression depending on the purpose of the internet use (Bessiere et al., 2008; Bessiere et al., 2010; Morgan & Cotten, 2003). In the study conducted by Morgan & Cotton (2003), it was found that both chat room and e-mail hours were associated with lower risk of depression, whereas time spent ‘surfing’ the internet (e.g. using the internet for games, shopping, research) was associated with greater risk of depression. Similarly, Bessiere et al. (2008) and Bessiere et al (2010) found using the internet to communicate with friends and family was associated with lower levels of depression. However, using the internet to meet new people (Bessiere et al., 2008) or to search for health-related information (Bessiere et al., 2010) was associated with greater levels of depression. Both those studies found no association between
using the internet to gather non-health-related information or for entertainment purposes, and risk of depression.

Finally, one randomised controlled trial, which recruited participants (aged 10+) from households that had recently bought a new computer or television, examined the impact of producing access to the internet, e-mail and using the computer in general on risk of depression (Kraut et al., 2002). Those in the intervention were offered free internet for 12 months to encourage internet and computer usage, with the control group being offered an equivalent amount of money to participate. Recent television purchasers were considered as a comparison group as they were less likely to use the internet. The intervention group showed no change in the risk of depression relative to the comparison group in this study (Kraut et al., 2002). However, the criteria used to define the intervention and control groups were based on assumptions that may have been invalid. Further, the age range of participants was large and non-specific (e.g. over 10 years of age). As adults and children have different purposes for using computers (e.g. children may use computers to play games and chat to friends, while adults may use computers for work, e-mails, shopping), a target group with a narrower age range may have resulted in the detection of significant associations between computer/internet use and risk of depression.

**Summary**

While the findings of this review are not unequivocal, on the whole they are suggestive of a positive association between sedentary behaviours and risk of
depression. However, in a number of cases findings varied depending on the specific type and purpose of the sedentary behaviour. In addition, the causality and mechanisms linking sedentary behaviour and depression require further investigation, as the majority of studies included in this review were cross-sectional. For example, it is not known whether time spent in sedentary behavior increases the risk of depression, or whether those experiencing depressive symptoms tend to spend greater amounts of time engaged in sedentary behaviours as a consequence of their depression. Furthermore, self-report measures in studies generally neglected to determine whether participants were being active/standing up whilst concurrently engaging in activities classed as ‘sedentary behaviours’ such as television viewing or computer use (e.g. watching television while working out or playing active ‘new generation’ computer games). Therefore, most studies could only assume that participants were being sedentary for the time reported. Nevertheless, recent research has suggested that although playing ‘new generation’ computer games (e.g. Nintendo Wii sports games) expends more energy than playing sedentary computer games, the energy used is unlikely to be enough to contribute towards the daily recommended dose of physical activity in children and adolescents (Graves et al., 2008).

This review highlights existing research gaps, with further studies needed to examine the associations of different types of sedentary behaviours and overall sitting time with risk of depression; the temporal relationship between sedentary behaviours and risk of depression; and the possible inter-relationship between physical activity, sedentary behaviour and risk of depression. There is also a need
for research identifying intervention strategies aimed at reducing sedentary behaviour and their effects on risk of depression within various population subgroups such as socio-economically disadvantaged women.

The following Chapter reviews the literature that has examined the correlates of physical activity and sedentary behaviour, particularly amongst socio-economically disadvantaged women. Understanding the correlates of physical activity and sedentary behaviour is important for informing the development of targeted intervention strategies aimed at reducing the risk of depression through increasing physical activity and reducing sedentary behaviour, in particular amongst at-risk groups such as socio-economically disadvantaged women. Existing strategies aimed at reducing women’s risk of depression through physical activity are also reviewed in the following chapter.
CHAPTER 3: Literature review (Part 2)

Although a number of previous reviews have assessed the correlates of physical activity amongst adults (Owen et al., 2004; Trost et al., 2002) and women (Eyler et al., 2002), no previous reviews have specifically examined the correlates of physical activity amongst socio-economically disadvantaged women or the correlates of sedentary behaviour amongst women. Furthermore, no reviews have examined intervention strategies used in physical activity interventions to reduce the risk of depression amongst women. Understanding the intra-personal, social and physical environmental correlates of physical activity and sedentary behaviour amongst women (in particular those who are socio-economically disadvantaged) may be a key component to inform the development of targeted intervention strategies to reduce the risk of depression through promoting an active lifestyle.

This literature review (Part 2) is presented in three sections. **Review three** (section 3.1) examines the correlates of physical activity, whilst **Review four** (section 3.2) identifies the correlates of sedentary behaviour. **Review five** (section 3.3) provides an overview of findings of intervention strategies aimed at reducing the risk of depression through physical activity. Where possible, the reviews focussed on women, specifically those experiencing socio-economic disadvantage, but in many cases there were too few/no studies of this target group so where this was the case, this is noted and studies of a broader adult population are included.
3.1. Review 3: Correlates of physical activity amongst socio-economically disadvantaged women

Given the associations observed between physical activity, sedentary behaviour and depression, there is good impetus for initiatives aimed at promoting physical activity and reducing sedentary behaviour, particularly amongst socioeconomically disadvantaged women, as a potential strategy for reducing risk of depression in this key target group. In order to do so effectively, a better understanding of the determinants of physical activity and sedentary behaviour is necessary. Correlates of physical activity can be broadly described in terms of intra-personal, social and physical-environmental factors, which follows the social-ecological model of human behaviour (Sallis & Owen, 1999). This framework has been widely used in previous reviews of physical activity correlates amongst women (Eyler et al., 2002), children (Sallis, Prochaska, & Taylor, 2000) and adults in general (Trost et al., 2002), and has been utilised as a means of summarising literature in the following reviews presented in this chapter. As socio-economically disadvantaged women are at high risk of physical inactivity (Armstrong, Bauman, & Davies, 2000; Bensenor, Rexrode, & Manson, 1999) and depression (Hobfoll et al., 1995; Weissman & Olfson, 1995), it is important to investigate the correlates of physical activity in order to develop specified programs aimed to increase physical activity and in turn reduce depression in this ‘at-risk’ population group.
3.1.1. Methodology

**Search strategy**

A detailed search for original research articles published post-1985 was conducted between the period of February 2008 to January 2011. Electronic databases that were utilised for the literature search included: MEDLINE (via pubmed), Psychinfo, Cinahl, Science Direct, Google Scholar and Expanded Academic. Included in the search were the following terms: physical activity, exercise, women, socio-economic status, socio-economic position, low income, depression, mental health, correlates, determinants, influences and barriers. Reference lists of relevant studies and reviews were further examined, as well as links to ‘related articles’ within electronic databases.

**Inclusion/exclusion criteria**

Observational (i.e. cross-sectional, longitudinal and qualitative) studies were included in this literature review. The review identified no intervention studies that examined the correlates of physical activity in socio-economically disadvantaged women. Further, abstracts, dissertations, and studies published before 1985 were excluded. This review focused on ‘healthy’ socio-economically disadvantaged women aged 18-60 years (i.e. those without serious underlying medical conditions that may confound statistical relationships). Those studies may have included men but for inclusion in this thesis results were required to be presented separately for each gender. Women were required to be classed as ‘socio-economically disadvantaged’ according to at least one indicator (e.g. low level of education, low income, or low occupational status). Those studies may
have included women of higher socio-economic positions; however, results were required to be presented separately for each socio-economic group. Further, studies were to include at least one measure of an intra-personal, social or environmental correlate of physical activity.

### 3.1.2. Correlates of physical activity in socio-economically disadvantaged women

The review identified a total of 13 studies that examined the correlates of physical activity in socio-economically disadvantaged women (Appendix 2, Table A.3.1). Of those studies, six were qualitative studies (Ball et al., 2006; Bove & Olson, 2006; Chang et al., 2008; Hoebeke, 2008; Juarbe, 1998; Wilbur et al., 2002), six included cross-sectional survey data (Brownson et al., 2001; Clark & Nothwehr, 1999; Cleland et al., 2008a; Osuji et al., 2006; Treiber et al., 1991; Yeager, Macera, & Merritt, 1993), and one included both qualitative and cross-sectional aspects (Brown et al., 2001b). The key methods and findings of those studies are presented in Table A.3.1 (Appendix 2). The following sections provide a detailed review of the major intra-personal, social and environmental correlates of physical activity identified in those studies. Studies identified included healthy women of low socio-economic position (based on income, occupational status and/or education) and were from Australia or the US. Physical activity and its correlates were assessed in cross-sectional studies using items adapted from well known surveys/scales such as the Behavioural Risk Factor Surveillance System (Gentry et al., 1985), the Social Support for Exercise Scale (Sallis et al., 1987) and the Baecke Physical Activity Scale (Baecke, Burema, & Frijters, 1982).
Intra-personal correlates of physical activity in socio-economically disadvantaged women

The following section examines the intra-personal correlates of physical activity (including some of those mentioned) in samples of socio-economically disadvantaged women in order to understand what personal factors may affect their physical activity patterns. While several non-modifiable demographic factors were identified, including age (Yeager, Macera, & Merritt, 1993), race/culture (Hoebeke, 2008; Juarbe, 1998; Wilbur et al., 2002) and marital status (Yeager, Macera, & Merritt, 1993), focus here is given to the potentially modifiable factors. Income, education and occupational status are also frequently demonstrated as correlates of physical activity; however, as the current review specifically focused on socio-economically disadvantaged women (defined by either income, education, or occupational status), discussion of those correlates have been omitted from this review.

General health

Four studies (three cross-sectional (Brown et al., 2001b; Clark & Nothwehr, 1999; Osuji et al., 2006) and one qualitative study (Hoebeke, 2008)) examined poor health and all four found that women reported it as a barrier to physical activity. Furthermore, Osuji et al. (2006) found a significant relationship between poor health and odds of meeting moderate physical activity recommendations.
Time constraints

A total of six studies (three qualitative (Ball et al., 2006; Hoebeke, 2008; Juarbe, 1998) and three cross-sectional (Brown et al., 2001b; Brownson et al., 2001; Osuji et al., 2006)) examined time constraints in this review. Of those studies, lack of time was commonly reported as a barrier to physical activity amongst socio-economically disadvantaged women in five studies (Ball et al., 2006; Brown et al., 2001b; Brownson et al., 2001; Hoebeke, 2008; Juarbe, 1998). Further, time constraints due to children were reported in all five of those studies. In fact, the cross-sectional study by Brown et al. (2001b) found that every mother who participated in their study reported having no time due to commitment to children as a predominant barrier to their physical activity. Other reasons for the socio-economically disadvantaged women’s perceived lack of time for physical activity included; housework (Brown et al., 2001b; Hoebeke, 2008; Juarbe, 1998); shopping (Brown et al., 2001b); commitment to partner (Brown et al., 2001b); and work (Ball et al., 2006; Brown et al., 2001b; Hoebeke, 2008; Juarbe, 1998).

However, of the studies that actually assessed the associations between correlates and physical activity, one cross-sectional study (Osuji et al., 2006) found no significant relationship between reporting a ‘lack of time’ for physical activity and meeting the moderate physical activity recommendations (150 minutes per week (American College of Sports Medicine, 2000)) in women of a low socio-economic position. Interestingly, reporting a ‘lack of time’ was associated with not meeting the physical activity guidelines in women who were of a higher socio-economic position (household income >$25,000) (Osuji et al., 2006).
However, that study involved only women from rural areas, which limits the generalisability of results.

**Lack of energy**

Feeling tired or lacking energy was a barrier to physical activity reported by socio-economically disadvantaged women in all five studies examining this determinant (Ball et al., 2006; Brown et al., 2001b; Brownson et al., 2001; Hoebeke, 2008; Osuji et al., 2006). Ball et al. (2006) and Hoebecke et al. (2008) found in their qualitative studies that this lack of energy stemmed from factors such as working. Brown et al. (2001b) found in their cross-sectional study that 77% of socio-economically disadvantaged women reported lacking energy as a constraint to physical activity. However, only 11% of low income women in the cross-sectional study by Brownson et al. (2001) reported lacking energy as a barrier to physical activity. This large difference may be due to the fact that Brown et al. (2001b) studied a sample of mothers with young children, a group that has been identified as having the least amount of free time for sleeping/resting when compared to women without children (Australian Bureau of Statistics, 1998). The one cross-sectional study that examined the statistical association between reporting a lack of energy and meeting physical activity recommendations in a sample of socio-economically disadvantaged women (Osuji et al., 2006) found a significant correlation between the two variables.
Work-related physical activity

Although three studies in this review included work-related physical activity as a possible correlate of overall physical activity (Brownson et al., 2001; Osuji et al., 2006; Wilbur et al., 2002), results were inconsistent. The cross-sectional study by Brownson et al. (2001) found that perceiving that enough exercise is obtained from work-related activities was the most commonly reported barrier to leisure-time physical activity amongst low-income women. Interestingly, the qualitative study by Wilbur et al. (2002) indicated that women viewed their occupation as either a barrier or enabler to physical activity, depending on the type of work undertaken (e.g. women in clerical positions were mostly sedentary, whilst service jobs such as childcare were reported to be physically demanding). However, in the one study that actually assessed the association between work-related physical activity and achieving the physical activity recommendations amongst disadvantaged women (Osuji et al., 2006), no significant correlations were found between obtaining physical activity on the job and meeting the physical activity guidelines.

Lack of Motivation

Three studies have examined motivation as a potential influence to physical activity in socio-economically disadvantaged women (Ball et al., 2006; Hoebeke, 2008; Osuji et al., 2006). In the qualitative studies by Hoebeke et al. (2008) and Ball et al. (2006), disadvantaged women mentioned a lack of motivation as a factor which prevented them from being physically active. However, one cross-sectional study found no association between reporting motivation and meeting
the physical activity guidelines in women of low socio-economic position (Osuji et al., 2006). Interestingly, in that study, a positive association was found between motivation and meeting the physical activity guidelines in women of a high socio-economic position. That study assessed physical activity in terms of meeting the national guidelines [150 minutes of moderate intensity physical activity per week (Pate et al., 1995)]. However, utilising a continuous measure, or several categories of physical activity, may be a more appropriate and sensitive method of assessing the statistical relationship between specific correlates and physical activity. It may also be that among socio-economically disadvantaged women, factors other than motivation may be more important.

**Enjoyment**

Enjoyment of physical activity was reported to be a correlate of physical activity in all three cross-sectional studies which examined this (Brown et al., 2001b; Cleland et al., 2008a; Osuji et al., 2006). Brown et al. (2001b) found that 30% of socio-economically disadvantaged women reported not enjoying physical activity as a constraint to participation. Further, Osuji et al. (2006) and Cleland et al. (2008a) found that women were less likely to meet the physical activity recommendations when they did not enjoy physical activity. This suggests the need for further research examining the reasons why women of a low socio-economic position may not enjoy physical activity and to consider activities that may promote enjoyment when designing interventions.
**Physical activity history**

A total of two studies assessed women’s past exercise experience (Ball et al., 2006; Clark & Nothwehr, 1999). Ball et al. (2006) found in their qualitative study that women of a low socio-economic position generally described their past physical activity experiences in a negative context, for example, not enjoying school sport. However, that study did not compare women’s past experience with current physical activity patterns, an aspect which may be important to consider when understanding the correlates of physical activity. Clark et al. (1999) found that past exercise experience was identified as a determinant of physical activity by only 21% of women. However, that study included a sample of older adults (aged 55 and over), which may increase the potential for recall difficulty.

**Feeling self-conscious**

Only three studies considered feeling self-conscious as a correlate of physical activity in socio-economically disadvantaged women (Hoebeke, 2008; Osuji et al., 2006; Wilbur et al., 2002), and results were varied. Wilbur et al. (2002) and Hoebeke et al. (2008) found in their qualitative studies that low-income women described feeling self-conscious as a barrier to physical activity as they feared being teased about their looks when exercising. However, in the study by Hoebeke et al. (2008), only the overweight women reported being self-conscious when exercising. In contrast, the cross-sectional study by Osuji et al. (2006) found no significant association in low-income women between feeling self-conscious about their looks and meeting the physical activity recommendations.
Other intra-personal factors

Self-efficacy, intention to be active and having a set physical activity routine were all factors that were positively associated with achieving the physical activity recommendations in the study by Cleland et al. (2008a). Since no other studies have assessed these correlates of physical activity amongst disadvantaged women, further research is warranted to confirm these findings.

Social correlates of physical activity in socio-economically disadvantaged women

The following section examines the social factors that enable and/or inhibit physical activity in socio-economically disadvantaged women.

Children

Seven studies examined having children/family responsibilities as a potential correlate of physical activity (Ball et al., 2006; Brown et al., 2001b; Brownson et al., 2001; Chang et al., 2008; Hoebeke, 2008; Juarbe, 1998; Osuji et al., 2006). Of those studies, having children/family responsibilities was a commonly reported barrier to physical activity amongst disadvantaged women in six studies (Ball et al., 2006; Brown et al., 2001b; Brownson et al., 2001; Chang et al., 2008; Hoebeke, 2008; Juarbe, 1998). For example, Hoebeke et al. (2008) found that most women, particularly single mothers, mentioned having a lack of childcare as a major barrier to physical activity. However, one cross-sectional study (Osuji et al., 2006) found that having no childcare was an enabler of physical activity. It may be that mothers in that study were able to incorporate physical activity with
their children. However, women without children could potentially confound the results of this particular analysis, (e.g. women without children would not report having ‘no childcare’ as a barrier to physical activity).

**Having an exercise companion**

A total of four studies in this review considered having an exercise companion as a correlate of physical activity (Ball et al., 2006; Brown et al., 2001b; Brownson et al., 2001; Osuji et al., 2006). Brownson et al. (2001) found that 80% of low-income women reported exercise with a friend or family member as a factor that positively influenced their physical activity behaviour. Similarly, Brown et al. (2001b) found 71% of women (mothers) in a low socio-economic position reported having no one to exercise with as a barrier to physical activity. Osuji et al. (2006) provided further evidence for this correlation as they found ‘having no one to exercise with’ to be significantly associated with not meeting the physical activity recommendations. However, in contrast, one qualitative study (Ball et al., 2006) found that lacking an exercise companion was not frequently cited as a barrier to physical activity as women (in particular mothers) often reported that they enjoyed the time alone. These findings suggest that women may differ in their preference of the social context of physical activity and that physical activity interventions must be tailored to individual’s needs and preferences.

**Friends and family support**

Apart from being active together, other forms of support from friends and family have been suggested as being beneficial in promoting physical activity
participation in women of various socio-economic positions (Nies, Vollman, & Cook, 1999; Sallis, Hovell, & Hofstetter, 1992). A total of eight studies in this review investigated other forms of social support amongst socio-economically disadvantaged women (Brown et al., 2001b; Brownson et al., 2001; Clark & Nothwehr, 1999; Cleland et al., 2008a; Hoebeke, 2008; Juarbe, 1998; Osuji et al., 2006; Treiber et al., 1991). Friend and/or family support provided through encouragement was a commonly reported enabler to physical activity in six studies (Brown et al., 2001b; Brownson et al., 2001; Clark & Nothwehr, 1999; Hoebeke, 2008; Juarbe, 1998; Treiber et al., 1991). Juarbe’s (1998) qualitative study found that women perceived their decision to exercise would be reaffirmed and their motivation to be physically active would increase when they sought information about physical activity from family and friends. About a quarter of the socio-economically disadvantaged mothers in one study (Brown et al., 2001b) reported having a friend or family member offer to mind their children to create an opportunity for them to be physically active (Brown et al., 2001b), whilst only 5% of mothers had a family or friend take over their chores in order to enable them to be physically active. The cross-sectional study by Treiber et al. (1991) found that in general friend and family support was positively associated with leisure-time physical activity and sports participation. However, no associations were seen between friend or family support and work-related physical activity in that study.

In contrast, one study found that social support from friends or family was not associated with meeting the physical activity guidelines (Cleland et al., 2008a).
Similarly, one cross-sectional study (Osuji et al., 2006) investigated whether being discouraged by others (e.g. family, friends, partner) was related to not meeting the physical activity recommendations (i.e. 150 minutes per week (American College of Sports Medicine, 2000)). That study revealed no significant association between the two factors, suggesting that the beneficial impact of positive social support (e.g. having others offer to be physically active with you) may be more influential for socio-economically disadvantaged women’s physical activity than any adverse impact of negative social support (e.g. being discouraged from physical activity).

Emerging from a number of studies was the recognition of the impact that partners (significant others) have on physical activity (Wallace, Raglin, & Jastremski, 1995). Only two studies have considered this in women of low socio-economic position (Brown et al., 2001b; Juarbe, 1998). Brown et al. (2001b) found that 65% of women reported being given encouragement from their partners to engage in physical activity. Further, 44% of mothers reported having a partner offer to mind the children so they could be more active (Brown et al., 2001b). In contrast, Juarbe (1998) found that several Mexican immigrant women were denied the opportunity to be physically active by their partner/husband, revealing that their partners would get angry with them if they exercised. This negative partner support inevitably influenced their decision to stop undertaking physical activity. However, as that study included only Mexican immigrants, results may not be generalised to all socio-economically disadvantaged women.
However, neither the study of Brown et al. (2001b) or Juarbe (1998) examined how partner support was statistically associated with women’s physical activity.

**GP support**

Only one cross-sectional study has considered doctor support as a correlate of physical activity in socio-economically disadvantaged women (Clark & Nothwehr, 1999). It was found that 45% of women endorsed verbal persuasion from their doctor as an enabler of physical activity. However, that study included a sample of older adults who had visited a particular general medicine practice within 12 months prior to the commencement of the study, hence, the generalisability of results is limited. Further studies are needed to better understand the impact of doctor support/persuasion on physical activity participation in women of low socio-economic position.

**Community support and role models**

Although only one qualitative study considered community support/role models as influences on physical activity in socio-economically disadvantaged women (Wilbur et al., 2002), this may be an important component of the social influences on physical activity. Women in the study by Wilbur et al. (2002) reported that a lack of community support and role models discouraged them from being physically active. As they did not see women in their neighbourhood exercising, they feared standing out or being teased if they did exercise, which prevented them from undertaking physical activity. Participants in that study were African-American women; whether these findings are generalisable to women from other
ethnic backgrounds is unknown. Further research investigating the relationship between community support/role models and physical activity in socio-economically disadvantaged women of all races is needed.

**Physical environmental correlates of physical activity in socio-economically disadvantaged women**

Research on the environmental influences on physical activity behaviour has increased in recent times with a number of reviews exploring these correlates (Owen et al., 2004; Trost et al., 2002). The following section examines the predominant environmental factors that influence physical activity in socio-economically disadvantaged women.

**Costs**

Undertaking physical activity can at times involve costs, such as clothing or equipment costs; entry fees for leisure facilities such as gyms; or costs of utilising cars or public transport to get to places to exercise. In this review a total of four studies found women reported costs as a barrier to physical activity (Bove & Olson, 2006; Brown et al., 2001b; Hoebeke, 2008; Wilbur et al., 2002). In their qualitative study, Bove & Olsen (2006) found that some participants were unable to afford to own vehicles, effectively hindering their ability to get to places to undertake leisure-time physical activity. The cross-sectional study conducted by Brown et al. (2001b) found that 82% of women from a low socio-economic position reported a lack of money as a constraint to physical activity. However, that study included a small sample size of socio-economically disadvantaged
women which may be a limiting factor. Conversely, one qualitative study (Ball et al., 2006) found cost was not a major barrier to physical activity in women of low socio-economic position, with most women recognising low-cost physical activity opportunities such as walking.

*Aesthetics of neighbourhood/scenery*

Three studies examined neighbourhood aesthetics as a potential influence on physical activity amongst socio-economically disadvantaged women. Of those, two studies found neighbourhood aesthetics to be an influence on physical activity (Ball et al., 2006; Brownson et al., 2001). Brownson et al. (2001) found women of low socio-economic position were less likely to report having enjoyable scenery in their neighbourhood than women of a higher socio-economic position. However, that study only included self-report measures of the physical environment and did not directly compare the amount of physical activity engaged in by those who did and did not report enjoyable scenery. Therefore, it is unclear as to the association between the aesthetics of the environment and physical activity level. Similarly, Ball et al. (2006) found in their qualitative study that women of low socio-economic position described their neighbourhood in a more negative manner, with one woman associating the poor aesthetic qualities of her neighbourhood with her lack of motivation to partake in physical activity. Again, the association between perception of neighbourhood aesthetics and individual’s physical activity levels was not assessed.
Conversely, one cross-sectional study found no association between perceived aesthetics and meeting the physical activity recommendations (Cleland et al., 2008a), suggesting that environmental correlates of physical activity may have been less important than intra-personal personal correlates of physical activity for disadvantaged women in that sample.

**Crime/safety**

A total of three qualitative studies (Ball et al., 2006; Hoebeke, 2008; Wilbur et al., 2002) and three cross-sectional studies (Clark & Nothwehr, 1999; Cleland et al., 2008a; Osuji et al., 2006) investigated crime/safety as a correlate of physical activity. All three qualitative studies (Ball et al., 2006; Hoebeke, 2008; Wilbur et al., 2002) found that a lack of safety was reported by women as a barrier to physical activity. Likewise, Clark et al. (1999) found that 61% of women in their study reported ‘fear of crime’ as a barrier to physical activity. However, when examining whether safety was cross-sectionally associated with meeting physical activity recommendations, Osuji et al. (2006) and Cleland et al. (2008a) found no significant relationship.

Although one cross-sectional study considered unattended dogs as a correlate of physical activity (Brownson et al., 2001), that study did not measure whether reporting unattended dogs was statistically associated with socio-economically disadvantaged women’s physical activity. It did, however, find that 49% of low-income women reported living in an environment where there were unattended
dogs, which warrants the need for further research to investigate whether such factors impact on participation in physical activity.

**Facilities**

In this review, facilities to enable physical activity included not only places to be active, such as leisure-centres/gyms, but also access to childcare, since this also provides an opportunity for women to exercise. Although four studies included in this review examined the availability of facilities in relation to physical activity (Ball et al., 2006; Brownson et al., 2001; Osuji et al., 2006; Wilbur et al., 2002), findings were mixed. Wilbur et al. (2002) found in their qualitative study that women perceived that indoor facilities were not easily accessible in their community, preventing them from undertaking physical activity. Similarly, Brownson et al. (2001) found that 30% of low-income women reported having no place to exercise. However, Ball et al. (2006) found in their qualitative study that a lack of (or poor) facilities was not often perceived as a barrier to women’s physical activity, regardless of socio-economic position. Women in that study generally reported availability of good facilities, however, they acknowledged the fact that they lacked the motivation to use them.

**Transport**

Access to transport can serve as a barrier or enabler to physical activity. Four studies have examined this in socio-economically disadvantaged women (Bove & Olson, 2006; Brown et al., 2001b; Hoebeke, 2008; Wilbur et al., 2002) with three of those studies (Bove & Olson, 2006; Brown et al., 2001b; Hoebeke, 2008)
reporting a lack of transport to be a barrier to physical activity. However, one qualitative study (Wilbur et al., 2002) suggested that public transport could be both a positive or negative influence on women’s physical activity. For example, although some women believed public transport encouraged them to be physically active by creating an opportunity for them to walk or run to the bus stop, other women believed that convenient access to public transport prevented them from physical activity as they no longer walked for transport (i.e. to shops or to work) (Wilbur et al., 2002). From this, it could be inferred that ready access to transport may provide greater opportunities for leisure-time physical activity in socio-economically disadvantaged women, yet in turn may reduce women’s transport-related physical activity.

Traffic

This review identified only three cross-sectional studies that examined traffic as a barrier to physical activity (Brownson et al., 2001; Cleland et al., 2008a; Osuji et al., 2006). Although 51% of low-income women reported heavy traffic as a characteristic of their neighbourhood in the study by Brownson et al. (2001), Osuji et al. (2006) and Cleland et al. (2008a) found no significant association between reporting heavy traffic and meeting the physical activity recommendations.

Neighbourhood structure

The structure of a neighbourhood includes street lights, sidewalks and roads, which may influence physical activity. Little research has examined
neighbourhood structure and physical activity in disadvantaged women. One cross-sectional study (Clark & Nothwehr, 1999) found that 32% of women reported poor or no sidewalks in their neighbourhood when investigating environmental influences on physical activity. Another qualitative study (Bove & Olson, 2006) suggested that living in a neighbourhood with few street lights or muddy/snow covered roads inhibited women’s physical activity participation. However, Cleland et al. (2008a) found no association between reporting having footpaths in good condition and meeting the physical activity guidelines. Given that so few studies have investigated neighbourhood structure as a correlate of physical activity within this population group, further studies are needed.

**Summary**

From this review of studies examining the intra-personal, social and physical environmental correlates of physical activity in women of low socio-economic position, it is clear that numerous factors across domains may affect physical activity participation in this target group. However, the number of studies remains small and the majority of those are descriptive. Further, few existing studies assess multiple correlates from different domains (intra-personal, social and physical environmental) comprehensively. Therefore, further studies are needed to understand the extent in which the individual, social and physical environment impacts on physical activity behaviour in socio-economically disadvantaged women. In the following section, studies investigating correlates of sedentary behaviours (e.g. television viewing, computer use) are reviewed.
3.2. Review 4: Correlates of sedentary behaviour amongst women

Given the positive associations between sedentary behaviour (particularly television viewing) and risk of depression shown in section 2.3, it is important that we have a thorough understanding of the influences on sedentary behaviour in order to reduce engagement in such behaviours.

3.2.1. Methodology

**Search strategy**

A detailed search for original research articles published post-1985 was conducted between the period of February 2008 to January 2011. Electronic databases that were utilised for the literature search included: MEDLINE (via pubmed), Psychinfo, Cinahl, Science Direct, Google Scholar and Expanded Academic. Included in the search were the following terms; sedentary behaviour(s), TV/television viewing, computer use, sitting time, inactivity, women, socio-economic status, socio-economic position, depression, mental health, correlates, determinants, and barriers. Reference lists of relevant studies and reviews were further examined, as well as links to ‘related articles’ within electronic databases.

**Inclusion/exclusion criteria**

Observational (i.e. cross-sectional, longitudinal and qualitative) studies were included in this literature review since no intervention studies examining the correlates of sedentary behaviour in women were identified. Further, abstracts, dissertations, and studies published before 1985 were excluded. This review
focuses on ‘healthy’ women aged 18-60 years (i.e. those not with serious underlying medical conditions that may confound statistical relationships). Those studies may have included men, but results were to be presented separately for each gender. Further, pregnant women and women who had recently given birth were also excluded from the review. Studies were to include at least one measure of an intra-personal, social or physical environmental correlate of sedentary behaviour.

Socio-economic position was not considered in this section, since preliminary searches of the literature revealed that very few previous studies had examined the correlates of sedentary behaviour in women of low socio-economic position specifically (Crawford, Jeffery, & French, 1999; Jeffery & French, 1998).

3.2.2 Correlates of sedentary behaviour in women

Much like physical activity, the correlates of sedentary behaviour can be described in terms of intra-personal, social, and environmental factors, following the socio-ecological framework of human behaviour (Sallis & Owen, 1999) (see section 3.1 for description of framework). From this review, it was apparent that most studies of the correlates of sedentary behaviour in women examined only intra-personal factors (e.g. weight status, income, age), with very few studies focussing on social (e.g. social support from friends and family) or environmental factors (e.g. physical activity environment, number of televisions in home).
A total of 30 studies assessing the relationship between specific correlates and sedentary behaviour in women were identified in this review. Of those studies, 27 were cross-sectional (Bertrais et al., 2005; Brown, Miller, & Miller, 2003; Buchowski & Sun, 1996; Buckworth & Nigg, 2004; Cameron et al., 2003; Clark et al., 2010; Cleland et al., 2008b; Duvigneaud et al., 2007; Fitzgerald et al., 1997; Healy et al., 2008b; Jacoby et al., 2003; Jakes et al., 2003; Johnson, Nelson, & Bradley, 2006; Kronenberg et al., 2000; Leite & Nicolosi, 2006; Liebman et al., 2003; Martinez-Gonzalez et al., 1999; Matthews et al., 2008; Pomerleau, McKeigue, & Chaturvedi, 1999; Sanchez et al., 2008; Sidney et al., 1996; Sugiyama et al., 2008a, 2008b; Sugiyama et al., 2007; Tucker & Bagwell, 1991; Varo et al., 2003; Williams et al., 1999) and three were longitudinal (Crawford, Jeffery, & French, 1999; De Cocker, van Uffelen, & Brown, 2010; Jeffery & French, 1998). The key methods and findings of studies investigating the correlates of sedentary behaviour in women are presented in Table A.3.2 (Appendix 2). The following sections provide a detailed review of the correlates of sedentary behaviour identified in those studies. Studies included healthy women, predominately from the U.S and Australia. Sedentary behaviour correlates were measured using reliable scales such as the Modifiable Activity Questionnaire (Vuillemin et al., 2000) and the Health Insurance Plan (HIP) of New York Activity Questionnaire (Shapiro et al., 1965).

**Intra-personal correlates of sedentary behaviour in women**

The following section examines the intra-personal correlates of sedentary behaviour in women. While several non-modifiable demographic factors were
identified, including income (Crawford, Jeffery, & French, 1999; Sidney et al., 1996; Sugiyama et al., 2007), education (Sidney et al., 1996; Sugiyama et al., 2007; Tucker & Bagwell, 1991; Varo et al., 2003), employment status (Brown, Miller, & Miller, 2003; Sanchez et al., 2008; Sidney et al., 1996; Sugiyama et al., 2007; Tucker & Bagwell, 1991; Williams et al., 1999), age (Sidney et al., 1996; Sugiyama et al., 2008a; Sugiyama et al., 2007; Tucker & Bagwell, 1991), race/culture (Matthews et al., 2008; Williams et al., 1999), marital status (Varo et al., 2003), and having children (Sanchez et al., 2008), focus here is given to the potentially modifiable factors.

**Weight Status**

A total of 21 cross-sectional studies (Bertrais et al., 2005; Buchowski & Sun, 1996; Cameron et al., 2003; Cleland et al., 2008b; Duvigneaud et al., 2007; Fitzgerald et al., 1997; Healy et al., 2008b; Jacoby et al., 2003; Jakes et al., 2003; Johnson, Nelson, & Bradley, 2006; Kronenberg et al., 2000; Leite & Nicolosi, 2006; Liebman et al., 2003; Martinez-Gonzalez et al., 1999; Pomerleau, McKeigue, & Chaturvedi, 1999; Sanchez et al., 2008; Sugiyama et al., 2008a, 2008b; Sugiyama et al., 2007; Tucker & Bagwell, 1991; Varo et al., 2003) and two longitudinal studies (De Cocker, van Uffelen, & Brown, 2010; Jeffery & French, 1998) examined weight status (i.e. Body Mass Index [BMI]) as a correlate of sedentary behaviour in women, with most studies finding a positive association between the two variables. In fact, only two cross-sectional (Fitzgerald et al., 1997; Sanchez et al., 2008) and one longitudinal study (De Cocker, van Uffelen, & Brown, 2010) found no association between weight
status and sedentary behaviour. However, those studies were subject to methodological limitations that may help to explain the null association. For example, Sanchez et al. (2008) included only overweight and obese adults in their sample and therefore the sample may have lacked sufficient weight-related heterogeneity to detect an association between sedentary behaviour and weight status.

Of the studies that found a positive association between weight and sedentary behaviour, 16 used ‘television viewing’ as an indicator of sedentary behaviour (Buchowski & Sun, 1996; Cameron et al., 2003; Cleland et al., 2008b; Duvigneaud et al., 2007; Healy et al., 2008b; Jacoby et al., 2003; Jakes et al., 2003; Jeffery & French, 1998; Johnson, Nelson, & Bradley, 2006; Kronenberg et al., 2000; Leite & Nicolosi, 2006; Liebman et al., 2003; Pomerleau, McKeigue, & Chaturvedi, 1999; Sugiyama et al., 2008a; Sugiyama et al., 2007; Tucker & Bagwell, 1991). Those studies found that greater weight/BMI was associated with greater time spent watching television. Although these findings provide strong evidence for a positive relationship between television viewing and weight/BMI, studies were primarily cross-sectional in nature. Similarly, both studies that included ‘sitting time’ as an indicator of sedentary behaviour found it was cross-sectionally associated with increased weight/BMI in women (Martinez-Gonzalez et al., 1999; Varo et al., 2003). Further, one cross-sectional study used a combined measure of television and computer use (Bertrais et al., 2005), whilst one other cross-sectional study included a self-reported ‘overall’ sedentary behaviour measure (Sugiyama et al., 2008b). Both of those studies found that time
spent undertaking sedentary activities was positively associated with greater weight/BMI. However, as both measures of sedentary behaviour were relatively broad, interpretation of results is limited.

From these findings, it is evident that a positive association exists between sedentary behaviour and weight/BMI. However, since all but one of the studies were cross-sectional in design, the direction of the relationship was unable to be determined. It should be noted that several longitudinal studies have assessed the (opposite) association between sedentary behaviour and weight gain (Blanck et al., 2007; Brown et al., 2005b; Crawford, Jeffery, & French, 1999; De Cocker, van Uffelen, & Brown, 2010; Hu et al., 2003; van Uffelen et al., 2010), with two finding a positive association, suggesting that increased time spent in sedentary behaviour increases subsequent weight gain (Brown et al., 2005b; Hu et al., 2003).

Physical Activity

Several studies examined the associations between sedentary behaviour and physical activity, with varied findings. Five cross-sectional studies found a negative association between sedentary behaviour and physical activity (Buckworth & Nigg, 2004; Fitzgerald et al., 1997; Sanchez et al., 2008; Sugiyama et al., 2008a; Sugiyama et al., 2007), with another study showing similar trends (Tucker & Bagwell, 1991). It could be that increased physical activity participation results in decreased time spent in sedentary activities (in particular television viewing), or that increases in sedentary behaviour lead to a reduction in
physical activity. However, as those studies were cross-sectional, causality could not be determined.

One cross-sectional study investigated several determinants of physical activity as factors that may be associated with television viewing (Williams et al., 1999). That study included the following variables: perceived barriers to physical activity, benefits of physical activity, enjoyment of physical activity and self-efficacy for physical activity. Results showed that women who reported a higher number of barriers to physical activity were more likely to spend greater time watching television. This finding suggests that those women may substitute time spent being physically active with time spent watching television.

A total of four studies found no association between television viewing and physical activity in women (Clark et al., 2010; Fitzgerald et al., 1997; Jeffery & French, 1998; Sidney et al., 1996). Fitzgerald et al. (1997) revealed no association between television viewing and occupational physical activity, however they did find an association between television viewing and leisure-time/total physical activity. As this was the only study that assessed the relationship between sedentary behaviour and physical activity in different domains, it is clear that further studies are needed, investigating participation in different domains of physical activity as potential correlates of sedentary behaviour.
Only one study found a positive association between physical activity and sedentary behaviour (Buckworth & Nigg, 2004). Interestingly, Buckworth & Nigg (2004) used ‘studying’ as an example of sedentary behaviour, revealing a relationship between increased studying and increased physical activity. This relationship may be confounded by the impact of education since highly educated women (who may be more likely to be studying) are more likely to participate in physical activity than women with a lower education (Yeager, Macera, & Merritt, 1993).

**Alcohol consumption and smoking status**

Only one study investigated the association between alcohol consumption and sedentary behaviour (television viewing) (Cleland et al., 2008b). That study found a positive association between alcohol consumption and television viewing, with increased alcohol correlated with increased television viewing. Likewise, two studies examined the association between smoking status and sedentary behaviour (Tucker & Bagwell, 1991; Varo et al., 2003). Varo et al. (2003) found a positive cross-sectional association between smoking status and sitting time, with smokers were more likely than non-smokers to spend long periods sitting down. Similarly, Tucker & Bagwell (1991) found a positive trend between smoking status and television viewing time; however, the significance of the association was not assessed. These findings suggest that unhealthy habits such as drinking alcohol and smoking may be associated with the amount of time women spend undertaking sedentary activities such as sitting and watching television.
**Energy intake/food consumption**

A total of two studies examined the association between energy intake and sedentary behaviours in women (Cleland et al., 2008b; Jeffery & French, 1998), with both finding a positive association between energy (food) intake and television viewing. The longitudinal study by Jeffery & French (1998) revealed that energy intake was associated with television viewing in both low- and high-income women. Further, Cleland et al. (2008b) found that snacking, as well as soft drink consumption, was related to increased television viewing time. In contrast to the studies described, one cross-sectional study found a negative association between poor eating habits and overall sedentary behaviour (Sanchez et al., 2008). That is, women with poor eating habits were less likely to be sedentary (as measured by an activity monitor). One explanation for this association suggested by the authors is that women who are always ‘on the go’ may both eat quickly/snack frequently and less healthily, as well as being more active (Sanchez et al., 2008).

**Other sedentary time**

Time spent watching television has been cross-sectionally linked to engaging in other sedentary behaviours. Sugiyama et al. (2008a) found that women who spent longer watching television also spent more time on the computer, playing video games, reading, driving in a car, and sitting in general.
Body dissatisfaction

Only one study examined the association between body dissatisfaction and sedentary behaviour (Williams et al., 1999). That cross-sectional study of university students found body dissatisfaction was positively associated with television viewing. Thus, women with higher body dissatisfaction were more likely to spend a greater amount of time watching television compared to women who were satisfied with their body. However, as that study included a sample of university seniors all from the same geographical location, the ability to generalize results is limited.

Social correlates of sedentary behaviour in women

Very few studies have examined the social correlates of sedentary behaviour in women, highlighting a major research gap. Only one cross-sectional study indirectly examined the social determinants of television viewing (Williams et al., 1999). That study of 321 female university seniors found that social support for physical activity was inversely associated with television viewing. However, when other covariates such as ethnicity and employment status were considered in the analyses, results did not remain significant. No other studies have investigated the social correlates of sedentary behaviour among women. As social support has been shown to be a strong predictor for women’s physical activity, further research on the importance of social factors in influencing sedentary behaviour is warranted. Providing social support and role models for reducing sedentary behaviours such as television viewing and leisure-time computer use
may comprise key strategies of efforts to promote more active lifestyles amongst women.

**Physical environmental correlates of sedentary behaviour in women**

As with the social correlates of sedentary behaviour, few studies have assessed the physical environmental determinants of sedentary behaviour. Existing studies are reviewed below.

*Neighbourhood walkability/physical activity environment*

Environmental factors such as the walkability of the neighbourhood have been examined in regards to physical activity participation (Bove & Olson, 2006). However, only two studies have assessed neighbourhood walkability in relation to television viewing (Sugiyama et al., 2007; Williams et al., 1999). Sugiyama et al. (2007) found that neighbourhood walkability was negatively associated with television viewing in women. In other words, women who lived in a neighbourhood that encouraged walking (e.g. living near shops) were less likely to watch television. This may be explained by neighbourhoods encouraging walking/physical activity leading to greater physical activity participation, displacing sedentary behaviour time. In contrast to the findings of Sugiyama et al. (2007), one cross-sectional study found that the physical environment had no association with television viewing in women (Williams et al., 1999).

Although the studies of Sugiyama et al. (2007) and Williams et al. (1999) measured the environment in terms of physical activity, neither study included
environmental measures that may directly affect sedentary behaviour. For example, neither measured aspects of the home environment such as how many televisions were available in participant’s homes. This is a major research gap, highlighting the need for further studies assessing the relationship between the physical environment including that in the home, and sedentary behaviour in women.

**Neighbourhood socio-economic position**

One study assessed the relationship between neighbourhood socio-economic position (SEP) and television viewing time in Australian adults (Sugiyama et al., 2007). Household weekly income of each district was used as an indicator of neighbourhood SEP. The study found that neighbourhood SEP was negatively associated with television viewing time. That is, women that lived in disadvantaged neighbourhoods were more likely to spend greater time watching television. This relationship may be explained by a number of factors. For example, high SEP neighbourhoods may have better neighbourhood design (van Lenthe, Brug, & Mackenbach, 2005) and access to facilities (Wilson et al., 2004) for being physically active, which in turn may displace television viewing time.

**Living in regional areas**

One cross-sectional study assessed the relationship between living in regional centres (versus capital cities) and television viewing time in Australian adults (Clark et al., 2010). That study found that living in regional areas was associated with higher odds of watching television when compared to living in capital cities.
The authors suggested that the lack of opportunity for recreational activities in regional areas may explain this relationship.

**Summary**

The results of this review demonstrate that the correlates of sedentary behaviour in women (in particular the social and environmental correlates) are highly understudied and relatively poorly understood. It is important to understand the various intra-personal, social and physical environmental correlates of a variety of sedentary behaviours (e.g. television viewing, computer use, sitting) in order to reduce these behaviours, and the associated adverse health outcomes in women, particularly those of a low socio-economic position. Such information may also provide insights to explain the inverse relationship between socio-economic position and sedentary behaviour among women, as well as to help inform the development of intervention strategies aimed to reduce sedentary behaviour in that target group.

**3.3. Review 5: Exploring intervention strategies to increase physical activity and reduce sedentary behaviour**

The following review identifies intervention strategies used in studies that aimed to promote physical activity in order to reduce the risk of depression in women (see section 2.2.1 for search strategy and inclusion/exclusion criteria). A total of 18 intervention studies were identified and included in this review. Intervention strategies targeting intra-personal, social and physical environmental correlates of physical activity are presented below (also see Appendix 2, Table A.3.3). Since
women with depressive symptoms are a group at risk of low compliance in physical activity (Azar et al., 2010), it is also important to consider compliance rates of physical activity interventions. Therefore, in this review compliance/adherence rates are reported where possible (based on the drop-out rate of intervention group participants reported by authors).

3.3.1 Physical activity intervention strategies targeting intra-personal determinants

**Cognitive Behavioural Therapy**

Cognitive behavioural therapy (CBT) is typically used by psychologists, and focuses on modifying cognitions, beliefs and reactions that influence emotions and behaviour (Whitefield & Davidson, 2007). Techniques often include participants keeping a diary of significant events and associated thoughts, feelings and behaviour, as well as questioning and testing cognitions (Whitefield & Davidson, 2007). Only one intervention study adopted CBT as a strategy to promote physical activity and reduce depressive symptoms in women (Anderson et al., 1999). A total of 16 group sessions, led by psychologists, were conducted following a version of the LEARN (Lifestyle, Exercise, Attitudes, Relationships, Nutrition (Brownell, 1994)) program for weight control. Participants were instructed using traditional behavioural methods which included keeping a physical activity record/log as well as discussing strategies with a psychologist for accumulating physical activity throughout the day. The intervention had an 88% compliance rate for exercise participation and was successful in reducing
depressive symptoms through the promotion of physical activity amongst participants (Anderson et al., 1999).

**Self-monitoring/feedback**

Of the 11 studies that included self-monitoring in their physical activity interventions (Anderson et al., 1999; Asbury, Chandruangphen, & Collins, 2006; Brown et al., 2001a; Craft et al., 2007; Cramer, Nieman, & Lee, 1991; King, Taylor, & Haskell, 1993; King et al., 1989; Nabkasorn et al., 2005; Nieman et al., 2000; Palmer, 1995; Pinchasov et al., 2000), a total of eight were successful in reducing the risk of depression (Anderson et al., 1999; Asbury, Chandruangphen, & Collins, 2006; Brown et al., 2001a; Craft et al., 2007; Cramer, Nieman, & Lee, 1991; King, Taylor, & Haskell, 1993; Nabkasorn et al., 2005; Pinchasov et al., 2000). Participants in three of those studies monitored their own heart rate by pulse palpation (manually) (Brown et al., 2001a; Pinchasov et al., 2000) or using heart rate monitors (Asbury, Chandruangphen, & Collins, 2006) in order to gain feedback on their progress and fitness. Such self-monitoring can serve as a motivational tool, and can increase physical activity adherence rates; for example, Ansbury et al. (2006) had a 97% physical activity compliance rate among participants. However, three other physical activity intervention studies that used heart rate monitoring were unsuccessful in reducing depressive symptoms (King et al., 1989; Nieman et al., 2000; Palmer, 1995). Possibly strategies such as heart rate monitoring need to be used in conjunction with other strategies to be successful in increasing adherence to physical activity and reducing the risk of depression.
Another self-monitoring technique, utilized in studies that found a decreased risk of depression in women at the end of the physical activity intervention, was the use of physical activity logs/records. A total of six studies reporting successful interventions required participants to keep a log or record of their daily physical activity (Anderson et al., 1999; Asbury, Chandrruangphen, & Collins, 2006; Brown et al., 2001a; Cramer, Nieman, & Lee, 1991; King, Taylor, & Haskell, 1993; Nabkasorn et al., 2005). This technique provides participants with direct feedback on their progress towards physical activity goals. Although most of those studies reported good compliance rate, King et al. (1993) found that in their group-based intervention, only 53% of women completed the physical activity intervention, suggesting that other strategies are important for increasing compliance to physical activity programs.

The use of activity monitors is a self-monitoring technique that has proven successful in promoting physical activity and reducing depression for two studies (Anderson et al., 1999; Craft et al., 2007). Participants in the study conducted by Anderson et al. (1999) wore accelerometers (which measure the duration and intensity of daily activities) for the length of the intervention, whilst participants in the study by Craft et al. (2007) wore pedometers (which count the number of steps taken each day). As both studies saw a reduction in depressive symptoms at the conclusion of the intervention, as well as having adherence rates of 75% (Craft et al., 2007) and 88% (Anderson et al., 1999), the use of activity monitors
may be a good motivational strategy for future physical activity interventions aimed at reducing the risk of depression in women.

One intervention study utilised a number of self-monitoring strategies to increase adherence to physical activity (Craft et al., 2007). Those strategies included each participant receiving an exercise calendar (to organise their physical activity each week), goal-setting information (used to help participants reach specific exercise goals), as well as fitness assessment feedback (this was provided by a physician at baseline and three months, and included heart rate, maximal oxygen consumption and body composition assessment). These strategies served predominately as a motivational technique to increase adherence to the prescribed physical activity intervention. Results showed a decrease in depressive symptoms at the end of the intervention and a physical activity program compliance rate of 75% (Craft et al., 2007).

**Education**

Providing educational information for participants in physical activity intervention studies was a strategy adopted by six studies in this review (Anderson et al., 1999; Asbury, Chandruangphen, & Collins, 2006; Brown et al., 2001a; Craft et al., 2007; Lee et al., 2001; Palmer, 1995), four of which found a reduction in depressive symptoms at the conclusion of the interventions (Anderson et al., 1999; Asbury, Chandruangphen, & Collins, 2006; Brown et al., 2001a; Craft et al., 2007).
Anderson et al. (1999) and Brown et al. (2001a) provided education/information on strategies for adopting and maintaining physical activity to participants in their intervention. This included discussion of how to overcome barriers to physical activity as well as ways to accumulate physical activity throughout the day. Similarly, Asbury et al. (2006) provided participants with suggestions for exercise e.g. joining a gym or exercise class. Those three interventions had high adherence rates (between 83-97%) and were effective in reducing the risk of depression in participating women. However, one other behavioural intervention (Lee et al., 2001) that provided educational tips for overcoming barriers to exercise had a slightly lower compliance rate (80%) as well as not finding any significant effect on risk of depression. That study, however, did not prescribe a physical activity program as such and therefore it is difficult to compare results to other physical activity intervention studies that have done so. Another educational technique used in two studies (Brown et al., 2001a; Craft et al., 2007) was providing participants with information regarding the mood-enhancing effects of physical activity. This gives participants further insight as to why physical activity is beneficial and therefore may work as a motivational technique. Both studies (Brown et al., 2001a; Craft et al., 2007) found women were at a decreased risk of depression after completing the intervention, with adherence rates at 83% and 75%.

**Individual Tailoring**

A ‘one size fits all’ approach to physical activity prescription is unlikely to be successful in increasing physical activity, Several studies identified in this review
considered ‘individual tailoring’ as a part of the intervention. All three studies that included an aspect of individual tailoring in their physical activity intervention found a decreased risk of depression in participating women (Anderson et al., 1999; Craft et al., 2007; Nabkasorn et al., 2005). Anderson et al. (1999) encouraged participants to increase the intensity of their activity (by increasing their step height in the aerobics class) when they felt they needed a greater challenge, whilst Nabkasorn et al. (2005) encouraged each participant to jog at their own pace. Both studies resulted in increased physical activity in participants as a result of the intervention. Adherence rates for those intervention studies were 88% and 92% respectively. Craft et al. (2007) provided participants with individualized walking programs based on their fitness test results. In doing this, participants were able to exercise at their own fitness level, which in turn may have made the activity more achievable and enjoyable, hence resulting in the increased physical activity and decreased depressive symptoms observed in this study.

The principle of progression

The principle of progression refers to increasing the duration, intensity or frequency of physical activity as the participant improves their fitness and/or coordination (Nieman, 2003). Of the four studies that included progression as a strategy in their physical activity intervention (Brown et al., 1995; King, Taylor, & Haskell, 1993; Nieman et al., 2000; Palmer, 1995), only two found a reduction in depressive symptoms at the end of the intervention (Brown et al., 1995; King, Taylor, & Haskell, 1993). Participants in the study by Brown et al. (1995)
undertook Tai-Chi classes, with new and more advanced movements being introduced later in the program. Physical activity participation increased amongst participants and the adherence rate of the intervention was 93%. Group-based exercise participants in the study by King et al. (1993) were instructed to increase the intensity of their walking/jogging gradually over the six-week period. However, only 53% of the participants adhered to that program, suggesting that perhaps progression is not as important as other strategies for promoting physical activity and reducing the risk of depression.

Additional Resources

The use of additional resources in physical activity interventions is a strategy that has been adopted by two studies (Anderson et al., 1999; Brown et al., 1995). Anderson et al. (1999) provided each participant with a video of the exercise class to use at home. Further, each participant was given a manual of the LEARN program (Lifestyle, Exercise, Attitudes, Relationships, Nutrition (Brownell, 1994)) for weight control, which informs women on different strategies for exercising and following a nutritious diet. Both these resources may have worked to increase the participant’s motivation to continue in the physical activity intervention, as 88% of women adhered to the program. Further, depressive symptoms were reduced at the end of the intervention. Another study (Brown et al., 1995) supplied participants in a walking group with a portable cassette player to listen to instructions about relaxing. Interestingly, those participants did not show a reduction in depressive symptoms at the conclusion of the intervention, although the intervention (which included other exercise groups) saw an increase
in physical activity and an overall adherence rate of 93%. As both studies that included additional resources in their physical activity interventions had a high adherence rate (Anderson et al., 1999; Brown et al., 1995), this could potentially be an effective strategy for further intervention studies.

3.3.2. Physical activity intervention strategies targeting social determinants

*Group (support) physical activity programs*

A total of 10 intervention studies identified in this review included an aspect of group physical activity as a part of the intervention (Anderson et al., 1999; Balkin et al., 2007; Berger & Owen, 1992; Brown et al., 1995; Craft et al., 2007; Cramer, Nieman, & Lee, 1991; King, Taylor, & Haskell, 1993; Nabkasorn et al., 2005; Palmer, 1995; Pilu et al., 2007). Of those studies, only one showed no significant inverse relationship between physical activity and risk of depression in women (Palmer, 1995), despite participants increasing their physical activity levels. Of the interventions that did show an effect on reducing depressive symptoms, adherence ranged from 53-93%. Interestingly, in the study by King et al. (1993), the individual (‘home-based’) group had a higher adherence rate (75%) than the group-based physical activity group (53%). This suggests that although the social context may be important for reducing depressive symptoms, it may not be as an important factor for increasing physical activity maintenance. Interventions targeting specific social determinants of physical activity identified are described below.
**Having a Coach/Supervisor/Counsellor**

Providing coaching or supervision for physical activity intervention participants is one means of offering social support. A total of nine studies incorporated this aspect into their physical activity interventions (Brown et al., 2001a; Craft et al., 2007; Cramer, Nieman, & Lee, 1991; Doyne et al., 1987; Nieman et al., 2000; Norvell, Martin, & Salamon, 1991; Palmer, 1995; Pilu et al., 2007; Pinchasov et al., 2000). Brown et al. (2001a) assigned a ‘coach’ to each participant, providing assistance with developing strategies to integrate physical activity into one’s daily routine, monitoring heart rate, calculating target heart rate etc. The intervention was successful in reducing the risk of depression in women through increased physical activity, and had an overall 83% compliance rate. Craft et al. (2007) included four (30-minute) counselling sessions to participants, aimed at increasing physical activity. A 75% compliance rate was seen, with depressive symptoms being significantly reduced at the conclusion of the intervention.

Of the seven studies that provided a supervisor for participants (Cramer, Nieman, & Lee, 1991; Doyne et al., 1987; Nieman et al., 2000; Norvell, Martin, & Salamon, 1991; Palmer, 1995; Pilu et al., 2007; Pinchasov et al., 2000), four were successful in reducing the risk of depression in women at the end of the physical activity intervention (Cramer, Nieman, & Lee, 1991; Doyne et al., 1987; Pilu et al., 2007; Pinchasov et al., 2000). The adherence rate for those successful studies ranged from 70-83%.
Collectively, these results suggest that providing a coach to participants could be an effective method for increasing social support for physical activity and in reducing the risk of depression in women. However, clearly this strategy may not be as feasible in terms of cost and practicality as having a single coach in a group format.

**Telephone calls**

Of the five studies that provided participants with telephone calls during the physical activity intervention (Brown et al., 2001a; Craft et al., 2007; King, Taylor, & Haskell, 1993; King et al., 1989; Lee et al., 2001), three were successful in reducing depressive symptoms in women (Brown et al., 2001a; Craft et al., 2007; King, Taylor, & Haskell, 1993). Both Brown et al. (2001a) and Craft et al. (2007) provided bi-weekly supportive telephone calls, assisting participants with overcoming barriers to physical activity and encouraging continued exercise participation. The adherence rates for these studies were 83% and 75% respectively. King et al. (1993) also provided telephone contact to their home-based exercise group throughout their 12-month intervention. That study found that although it was successful in reducing the risk of depression in both home-based and group-based exercise groups, adherence to the intervention differed greatly between groups. In fact, the home-based group had a 75% compliance rate, compared to the group-based exercise group who showed a 53% compliance rate. That study suggests that to increase adherence to physical activity in women, telephone calls may be an important strategy.
Chapter 3: Literature Review (Part 2)

3.3.3. Physical activity intervention strategies targeting environmental determinants

No intervention studies aimed at reducing the risk of depression through increasing physical activity targeting physical environmental determinants were identified in this review, highlighting a major research gap. One other way to consider/classify intervention studies is by the setting in which physical activity is undertaken. The following section describes those studies which considered ‘setting’ in interventions aimed at reducing the risk of depression in women.

3.3.4. Settings

A total of two studies identified in this review considered different settings for physical activity in their interventions (Craft et al., 2007; King, Taylor, & Haskell, 1993). Craft et al. (2007) included a home-based physical activity program, and a clinic-based program with both interventions showing a significant effect on increasing physical activity and reducing depressive symptoms in women. Further, drop-out in both groups was the same and very low. Similarly, King et al. (1993) included a home-based physical activity program and a community-based program. Both interventions showed a significant effect on increasing physical activity and reducing depressive symptoms in women. However, there was a great difference in adherence rates between the two groups, with the home-based group showing a higher compliance to the intervention than the community-based group. These findings show that although the setting for physical activity might not make a difference in reducing depressive symptoms, adherence to physical activity programs may differ
between settings, suggesting that this may be an important consideration when designing an intervention.

3.3.5. Sedentary behaviour intervention strategies

A literature search was also undertaken to identify intervention studies that were aimed at reducing the risk of depression through reducing sedentary behaviour (see section 2.3.1 for methodology). However, to date no intervention studies have been conducted to reduce the risk of depression through reducing sedentary behaviour. Therefore, no intervention strategies have been identified for this section. Rather, this highlights an important gap in the research examining the association between sedentary behaviour and risk of depression. Specifically, further intervention studies are needed in order to assess the effect of reducing sedentary behaviour on depressive symptoms.

3.4. Summary

The reviews presented in Chapter 2 and Chapter 3 identified various observational cross-sectional, longitudinal, qualitative and intervention studies which provide insights into women’s physical activity and sedentary behaviour and risk of depression. Specifically, the reviews have demonstrated evidence of an inverse association between physical activity and risk of depression in women, as well as a positive association between sedentary behaviour and risk of depression. Further, a number of intra-personal, social and physical environmental correlates of physical activity (amongst socio-economically disadvantaged women) and
sedentary behaviour (amongst women) have been identified. However, several research gaps still exist.

Evidence on the optimal domain and social context of physical activity for reducing the risk of depression is limited and inconsistent. Further, the context/types of sedentary behaviours more likely to lead to depression are also unknown. Although a range of intra-personal correlates of physical activity have been suggested, little research has identified the social and physical environmental correlates of physical activity amongst socio-economically disadvantaged women. Furthermore, no studies have examined the correlates of sedentary behaviours amongst socio-economically disadvantaged women and thus little is known as to which factors (intra-personal, social and physical environmental) may explain the inverse relationship between socio-economic position and sedentary behaviour (e.g. television viewing). Although, on the balance, physical activity intervention studies aimed at reducing the risk of depression through targeting intra-personal and social determinants in women were effective, no physical activity intervention studies have been designed to reduce risk of depression through targeting environmental determinants. Furthermore, none of those interventions included socio-economically disadvantaged women and therefore little is known as to the most effective strategies for increasing physical activity in order to reduce the risk of depression amongst this target group. Finally, no intervention studies have been conducted to reduce the risk of depression through reducing sedentary behaviour, highlighting a major research gap.
More research involving large, population-based samples is needed to investigate the associations between physical activity, sedentary behaviours and risk of depression in socio-economically disadvantaged women, as well as the correlates of these behaviours. In addition, further insights into the feasibility of different strategies to promote physical activity and reduce sedentary behaviour in this important target group are also needed.

3.5. Thesis aims and hypotheses

Little is known about the various components (domain and social context) of physical activity and sedentary behaviours most strongly linked to reducing the risk of depression; about the correlates of physical activity and sedentary behaviours amongst socio-economically disadvantaged women, or about the most feasible and effective ways to promote physical activity and reduce sedentary behaviour amongst socio-economically disadvantaged women. This PhD therefore aims to address several research questions. Specifically, it aims to investigate:

1. Associations between different domains (transport-related, work-related, domestic, leisure-time) of physical activity and risk of depression amongst women living in socio-economically disadvantaged neighbourhoods.

2. Associations between different social contexts (individual or accompanied) of physical activity and risk of depression amongst women living in socio-economically disadvantaged neighbourhoods.
3. Associations between different types/contexts (e.g. television viewing, sitting at the computer) of sedentary behaviour and risk of depression amongst women living in socio-economically disadvantaged neighbourhoods.

4. Correlates of physical activity and sedentary behaviour amongst women living in socio-economically disadvantaged neighbourhoods with depressive symptoms

5. The role of intra-personal, social and physical environmental factors in mediating socio-economic gradient in women’s television viewing.

6. The feasibility of potential intervention strategies to increase physical activity and reduce sedentary behaviour amongst women living in socio-economically disadvantaged neighbourhoods.

Based on the review of the literature, it is hypothesised that leisure-time physical activity will be most strongly associated with lower risk of depression in women living in socio-economically disadvantaged neighbourhoods, compared to other domains (transport-, work-related, domestic). Further, accompanied activities (e.g. group exercise classes) are hypothesised to be more strongly associated with lower risk of depression, compared to physical activities undertaken alone. It is also hypothesised that sedentary behaviours, particularly television viewing will be linked to increased risk of depression. Further, it is hypothesised that various intra-personal, social and physical-environmental factors will be associated with physical activity and sedentary behaviour amongst women living in socio-economically disadvantaged neighbourhoods, and that a number of intra-personal,
social and physical-environmental factors will explain the relationship between socio-economic position and sedentary behaviour (television viewing). Finally, it is hypothesised that intervention physical activity promotion and sedentary behaviour reduction strategies targeting intra-personal, social and physical-environmental determinants will be perceived as feasible amongst women living in socio-economically disadvantaged neighbourhoods.

3.6. Significance

Participating in regular physical activity, as well as reducing sedentary behaviours has a strong cardio-protective role and may also play an important role in the treatment and prevention of depression. By advancing understanding of the determinants of physical activity and sedentary behaviour and their socio-economic distribution, this study will inform the development of more effective programs and policies to increase population levels of physical activity and decrease sedentary behaviour, particularly among those at risk of inactivity and of depression (e.g. women living in socio-economically disadvantaged neighbourhoods).

A better understanding of associations between various components (e.g. the domain and social context) of physical activity, sedentary behaviour, and risk of depression, as well as correlates of physical activity and sedentary behaviour is necessary in order to inform the development of strategies to improve mental health through the promotion of an active lifestyle, particularly in women of low socio-economic position. The findings of this study will contribute to the
evidence base necessary to inform more effective interventions and programs to improve mental health in socio-economically disadvantaged women through the reduction of sedentary behaviour and participation in physical activity.
CHAPTER 4: A quantitative investigation of the associations between physical activity, sedentary behaviour and depression among women living in socio-economically disadvantaged areas †

4.1. Introduction

Participating in regular physical activity (Bauman, 2004) and reducing sedentary behaviours (Owen et al., 2010) help prevent a number of physical health conditions such as obesity, diabetes and cardiovascular disease, and may also play an important role in the treatment and prevention of depression (Sidney et al., 1996; Teychenne, Ball, & Salmon, 2008b). Women and socio-economically disadvantaged adults are at great risk of both physical inactivity (Gidlow et al., 2006; Sisson & Katzmarzyk, 2008) and depression (Lorant et al., 2003; Wilhelm et al., 2003). Further, disadvantaged groups are less likely to have access to health promotion programs (Satcher & Higginbotham, 2008) and therefore it is important that research focuses on such population groups. In particular, understanding the reasons for this increased risk of physical inactivity and depression as well as the nature of associations in this target group is needed in order to inform effective intervention strategies to reduce the risk of depression through promoting an active lifestyle.

† Note: A manuscript based on this chapter has been published and is attached in Appendix 3: Teychenne, M., Ball, K. & Salmon, J. 2010, ‘Physical activity, sedentary behaviour and depression among disadvantaged women’, Health Education Research, First published online Feb 2010.

An abstract of this chapter has also been published and is attached in Appendix 4: Teychenne M, Ball K, Salmon J. 2009 ‘Associations between physical activity, sedentary behaviour and risk of depression in socio-economically disadvantaged women’ (abstract). Journal of Science and Medicine in Sport (Supplement): 12(6); 33-34.
As highlighted in Chapter 2, various observational (Brown et al., 2005a; Teychenne, Ball, & Salmon, 2008a) and intervention (Doyne et al., 1987; Pinchasov et al., 2000) studies have found leisure-time physical activity of all intensities (i.e. light, moderate and vigorous) to be inversely associated with risk of depression among women. However, very few studies have assessed the association between depression and physical activity undertaken in other domains (e.g. work-related, domestic, transport-related). Furthermore, little research has looked at the optimal social context of physical activity for reducing the risk of depression in women. Although the majority of studies assessing the association between sedentary behaviours (e.g. television viewing) and risk of depression amongst adults have found a positive relationship (Dittmar, 1994; Kleinke, 1988; Sanchez-Villegas et al., 2008; Sanchez et al., 2008; Sidney et al., 1996; Thomee et al., 2007), the review presented in Chapter 2 showed that studies were few in number and weakened by methodological limitations such as small sample sizes (Dittmar, 1994) and crude/insensitive measures of sedentary behaviour (Kleinke, 1988). Furthermore, one study identified in Chapter 2 showed an inter-relationship between physical activity, sedentary behaviour and risk of depression (Sanchez-Villegas et al., 2008). However confirmation of findings is required and this has not yet been investigated in a disadvantaged sample.

A better understanding of associations between various components (e.g. the domain and social context) of physical activity, sedentary behaviour, and risk of depression, is necessary in order to inform the development of strategies to
improve mental health through the promotion of an active lifestyle, particularly in
women of low socio-economic position.

This chapter presents the findings of a quantitative cross-sectional survey
investigating the associations between components of physical activity (e.g.
domain and social context) and risk of depression amongst women living in
socio-economically disadvantaged areas, as well as the association between
different sedentary behaviours (e.g. television viewing) and risk of depression
amongst women living in socio-economically disadvantaged areas. The findings
of this study will contribute to the evidence base necessary to inform more
effective interventions and programs to improve mental health in socio-
economically disadvantaged women through the reduction of sedentary behaviour
and participation in physical activity.

4.2. Aims and hypotheses

The aims of this study were to examine among women living in socio-
economically disadvantaged areas:

1. Associations between different domains (leisure-time, domestic, work-
related or transport-related physical activity) of physical activity (of all
intensities) and risk of depression.

2. Associations between different social contexts of physical activity (alone
or accompanied) and risk of depression.
3. Associations between sedentary behaviours (e.g. television viewing, computer use) and risk of depression.

4. Interactions between physical activity, sedentary behaviour and risk of depression.

Based on the review of the literature presented in Chapter 2, it was hypothesised that leisure-time physical activity (of all intensities) would be most strongly associated with lower risk of depression in socio-economically disadvantaged women, compared to other physical activity domains (transport-, work-related, domestic). Further, accompanied activities (e.g. group exercise classes) would be most strongly associated with lower risk of depression, compared to physical activities undertaken alone. It was also hypothesised that sedentary behaviours such as television viewing and sitting at the computer would be linked to an increased risk of depression. Finally, it was hypothesised that there would be an interaction between physical activity, sedentary behaviour and risk of depression, such that the link between sedentary behaviour and risk of depression would be stronger amongst less physically active women than more physically active women.

4.3. Methods

The present study involved secondary statistical analysis of cross-sectional survey data collected in 2007/2008 from the Resilience for Eating and Activity Despite Inequality (READI) Study. The READI study collected information through mailed surveys from women aged 18-45, and living in low socio-economic areas. Data included women’s physical activity, sedentary behaviour, mental health and
socio-demographic details. The current study used this information to assess the associations between specific physical activity variables (domain and social context), sedentary behaviour variables (e.g. television viewing, computer use) and risk of depression. The methods and procedures are described below.

4.3.1. Participants

Participants in the READI study were recruited from 80 Victorian neighbourhoods (40 rural and 40 urban) of low socio-economic position (SEP). The measure of SEP was based on the Australian Bureau of Statistics SEIFA - Socioeconomic Index for Areas (Australian Bureau of Statistics, 2003), which is the most widely-used measure of area level SEP in Australia, and is based on aggregated variables including the proportions of residents with particular housing status, occupation, income and level of completed education (Australian Bureau of Statistics, 2003). Suburbs were used as neighbourhoods in the sampling. A suburb is a geographic subdivision/residential area that generally comprise anywhere between about 4000 and 30,000 residents. Suburbs ranked in the most disadvantaged tertile within Victoria, with a population of 1,200 people or more and (for logistical reasons) located within a 200km radius of Melbourne were included in the selection pool, and 40 rural, and 40 urban suburbs were randomly selected from this pool. The electoral roll was then used to randomly select 150 women aged between 18 and 45 years from each of the 80 suburbs. Where there were suburbs in which the number of eligible women was less than 150 (n=3 neighbourhoods), all eligible women from that suburb received a survey. The final sampling frame included 11,940 women.
Although area-based indicators are not a perfect proxy for socio-economic disadvantaged, they have been widely used as a measure of socio-economic position in health research (Galobardes et al., 2006b). In addition, area-based indicators of socio-economic position have been linked to lower leisure-time physical activity (Kavanagh et al., 2005; van Lenthe, Brug, & Mackenbach, 2005) and higher risk of depression (Ross, 2000), independent of individual level indicators.

READI women’s health surveys were sent to these 11,940 women, and a total of 4,934 women returned a completed survey representing a response rate of 45% (Macfarlane et al., 2010; MacFarlane et al., 2009). Of the respondents, 571 women were excluded due to residing in ‘non-READI’ neighbourhoods. A further 9 women were excluded due to falling outside the valid age range (i.e. either younger than 18 years or older than 46 years, or had data missing on this variable). Three women were excluded as the survey was not completed by the woman it was addressed to and two women later withdrew from the study. This left a total of 4,349 women included in the overall study. Since pregnancy is likely to affect both physical activity levels (Evenson, 2002; Sternfeld et al., 1995) and risk of depression (Bennett et al., 2004), 284 women (6%) were excluded from analyses because they reported being pregnant (or didn’t know their pregnancy status) or did not complete this question. A further 420 women (10%) were excluded due to having missing data on one or more covariates. This
left a total of 3,645 women (74% of original respondents) with data for inclusion in the analyses.

4.3.2. Ethics

Ethical approval from the Deakin University Human Research Ethics Committee was obtained for the READI study on which the analyses for this study are based (EC 91-2006). No further ethics approval was needed for this study.

4.3.3. Procedures

Women selected for the surveys were sent a pre-survey letter in the mail, informing them that they had been selected to take part in a study on women’s health and that the survey would be sent to them shortly. Surveys were posted out to the selected women one week later. Following the Dilman protocol (Dillman, 1978) non-respondents received a mailed reminder two weeks days later and a second reminder with a replacement survey a further two weeks later. Women received small incentives (e.g. tea bags, $1 scratchies\(^1\)) with their initial survey package.

4.3.4. Measures

The READI survey, which is included in Appendix 5, consisted of 106 questions and included self-report measures of socio-demographic characteristics, physical activity, sedentary behaviour and depressive symptoms.

\(^{1}\) Scratchies: Small cardboard lottery tokens which are scratched in order to win/reveal a cash prize.
4.3.4.1. Height, Weight, Pregnancy Status (see questions in Appendix 5 - A6-A8)

Women were asked to record their height and weight, as well as to indicate whether they were currently pregnant. Self-reported height and weight has been found to be a valid measure amongst Australian women (Burton, Brown, & Dobson, 2010).

4.3.4.2. Physical Activity (B3-B15, B19)

Physical activity was measured using the self-completion long form of the International Physical Activity Questionnaire (IPAQ-L), a validated measure involving a seven-day recall of physical activity behaviours (Craig et al., 2003). Its reliability has been tested and is comparable to most other established self-report methods (Brown et al., 2002; Craig et al., 2003). Questions included the frequency and duration of time spent undertaking various intensities (walking, moderate and vigorous) of physical activity in leisure-time, transport-related activity, work-related activity and domestic physical activity. For each of these domains, participants were required to estimate the number of days, hours and minutes they spent undertaking such activities in the past week. For example, to assess work-related physical activity the following questions were asked; “During the last 7 days, on how many days did you do vigorous physical activities like heavy lifting…and climbing up stairs as part of your work?” and “How much time did you usually spend on one of those days doing vigorous physical activities as a part of your work?” The same questions were asked for moderate-intensity work-related physical activity (see Appendix 5 for further details).
The *social context* of leisure-time physical activity was assessed through the following question, developed for this study: “Thinking about all of your walking, moderate and vigorous leisure-time physical activity in the last 7 days, about how much of this was done ON YOUR OWN (as opposed to with someone else like family, friend or in an exercise group or class)?”. Response categories included; all; most (about ¾); about half; a little (about ¼); none. The test-retest reliability of this measure was examined in a separate convenience sample of 58 women, of the same age range and demographics as the study sample, and defined as adequate (Kappa value = 0.625) (Landis & Koch, 1977).

**Management of physical activity scores**

Physical activity variables were summed across intensities to give a total duration of physical activity within each *domain* (leisure-time physical activity, domestic physical activity, work-related physical activity, transport-related physical activity). This was done by multiplying the frequency of activities by the duration, then truncating these data in each domain to remove unrealistic out of range values. The truncation ranges (including the upper data limits chosen as truncation points, as well as the percentage of data truncated) for physical activity variables were as follows: weekly vigorous physical activity at work was truncated at 15 hours (7.0% truncated), weekly moderate physical activity at work and walking at work were truncated at 30 hours (3.6% and 7.0% respectively). Total weekly leisure-time vigorous physical activity (0.9%), moderate physical activity (0.5%) and walking (2.0%) were all truncated at 14 hours. Total weekly
domestic physical activity was truncated at 42 hours (7.3%) and total weekly biking and walking for transport were truncated at 21 hours (<0.1 % and 2.7% respectively). The selection of truncation values was based on an internally-developed protocol used by the researches from the Centre for Physical Activity and Nutrition (Deakin University) for the truncation of data in the Socio-economic Status and Activity in Women (SESAW) study (Ball et al., 2007).

Each physical activity variable (e.g. vigorous leisure-time physical activity) was then collapsed into a categorical variable with three levels. The categories for these were selected to correspond as closely as possible to the tertiles of the particular distributions. Tertiles (rather than continuous variables) were utilised as the data were highly positively skewed, with a high proportion of women reporting no moderate or vigorous physical activity per week, a pattern not atypical in population based studies (Armstrong, Bauman, & Davies, 2000; Australian Bureau of Statistics, 2006a).

4.3.4.3. Sedentary Behaviour (B16-B18)

Four measures of sedentary behaviours were examined: overall time spent sitting (which included sedentary behaviours such as sitting at a desk, visiting friends, reading, watching television and driving) time spent sitting watching television, time spent sitting at a computer and total screen time (i.e. the sum of time spent sitting watching television and time spent sitting at the computer). Overall sitting in the past week (weekdays as well as weekends) was assessed using the IPAQ-L. Participants were asked to estimate the number of hours and minutes spent sitting
on a weekday, as well as a weekend day. Time spent sitting watching television and sitting using the computer were examined separately. Participants were asked to estimate the number of hours and minutes they spent undertaking each of those activities on a weekday, as well as a weekend day. For example, to assess computer sitting time the following questions were asked; “Of your total sitting time, during the last 7 days, how much time did you usually spend sitting at a computer on a weekday?” and “Of your total sitting time, during the last 7 days, how much time did you usually spend sitting at a computer on a weekend day?”. These measures have been found to be reliable and valid in an Australian adult population (Salmon et al., 2003).

**Management of sedentary behaviour scores**

Sedentary behaviour variables (overall sitting time, television viewing, using a computer) were summed to give a weekly duration of time spent in each sedentary activity. This was done by multiplying the duration of each sedentary behaviour performed on *weekdays* by five (days) then adding this to the *weekend days* total duration (duration multiplied by two [days]). The variable ‘weekly screen time’ (television viewing + computer use) was created by summing the weekly duration for the variables ‘television viewing’ and ‘computer use’. Data for each sedentary behaviour variable were then truncated. Total weekly sitting time (9.5%), television viewing time (1.6%), computer use (3.7%) and screen time (7.9%) were all truncated at 126 hours. Total weekly duration of overall sitting time, television viewing time, computer use, and screen time were then transformed into categorical variables with three levels. The cut-off points for
these were selected to correspond as closely as possible to the tertiles of the particular distributions.

4.3.4.4. Depressive symptoms (D3)

Depressive symptoms were assessed using the 10-item version of the Centre for Epidemiologic Studies Depression Scale (CES-D). This scale includes questions that relate to various symptoms of depression that may have been experienced in the past week. For each item respondents rated themselves on a 4-point severity scale. Examples include: “I was bothered by things that usually don’t bother me” [Rarely or none of the time; Some or little of the time; Occasionally or a moderate amount of the time; Most or all of the time]; “I was happy” [Rarely or none of the time; Some or little of the time; Occasionally or a moderate amount of the time; Most or all of the time]. The CES-D is a well-validated measure of depression (Andersen et al., 1994; Radloff, 1977) and has been used in previous studies examining the association between physical activity and depression (Galper et al., 2006; Stephens, 1988).

Management of depression scores

In reference to the CES-D, response categories for items 5 (“I felt hopeful about the future”) and 8 (“I was happy”) were reverse coded (i.e. respondents were scored 0 for responses indicating they experienced this “most or all of the time”; 1 for responses indicating they experienced this “occasionally or a moderate amount of time”; 2 for responses indicating they experienced this “some or little of the time”; 3 for responses indicating they experienced this “rarely or none of
the time”). For all other items (e.g. Item 3: “I felt depressed”), response categories were scored 3 for responses indicating they experienced this “most or all of the time”; 2 for responses indicating they experienced this “occasionally or a moderate amount of time”; 1 for responses indicating they experienced this “some or little of the time”; 0 for responses indicating they experienced this “rarely or none of the time”. Responses were then summed across the 10 items to provide a total score. CES-D scores of 10 or greater indicate that the participant is at risk of depression (Andersen et al., 1994). Participants were then categorised into either ‘at risk of depression’ or ‘not at risk of depression’ as per established protocols (Andersen et al., 1994).

4.3.5. Covariates (B1, E1, E5, E7-9, E12, and E22)

Age (categorised as under 25; 25-29; 30-35; 35-39; 40 years and over); BMI [categorised as not overweight (<25); overweight (25-29.9); obese (>30)]; marital status (categorised as living in a registered marriage/de facto relationship; separated/divorced/widowed; never married); education (categorised as did not complete high school; completed year high school or equivalent/trade/apprenticeship/certificate/diploma; university or higher university degree); employment status (categorised as working full-time; part-time; unemployed/laid off; keeping house/raising children full-time; studying full-time; retired); household income (categorised as no income; $1-$119 per week; $120 - $299 per week; $300 - 499 per week; $500 - 699 per week; $700 - $999 per week; $1000 - $1499 per week; $1500 or more per week; don’t know/don’t want to answer); children living at home (categorised as yes; no); country of birth
(categorised as Australia; other) and physical health (whether or not the participant reported having a serious illness, long-term injury or disability that prevents them from being physically active), were included in the analyses as potentially confounding factors, as these variables were bivariately associated with the risk of depression in chi-square analyses.

4.3.6. Statistical Analyses

Demographic characteristics of participants were initially examined using descriptive univariate analyses performed using SPSS version 14.0 statistical software. Descriptive statistics were used to characterise women's participation in the various domains of physical activity, whether participants were physically active with someone or alone, women’s participation in sedentary behaviours, and presence of depressive symptoms.

Bivariable associations between domains of physical activity, social context of physical activity, sedentary behaviour and risk of depression were examined using Chi-square analyses. Furthermore, risk of depression was also compared between women with missing data on at least one covariate (i.e. age, BMI, marital status, education, employment status, household income, children living at home, country of birth and physical health) and women with no missing data on any covariate, using a chi-square analysis. This was done in order to test whether excluding women who had missing data on one or more covariates from logistic regression analyses would affect results.
Crude (from bivariable analyses) and adjusted (from multivariable analyses, controlling for the potential confounding factors identified in section 2.5) odds ratios (OR) and 95% confidence intervals (CI) were then calculated for physical activity (domain and social context) and sedentary behaviour (predictor variables) and risk of depression (outcome variable) using logistic regression analyses. Logistic regression is a useful technique for predicting discrete outcomes (e.g. risk of depression) from a set of continuous or categorical variables (e.g. physical activity) (Tabachnick & Fidell, 1996). Further, logistic regression analyses were used to test for an interaction between sedentary behaviour (i.e. weekly sitting time), physical activity (i.e. total weekly leisure-time physical activity) and risk of depression. Logistic regression analyses controlled for clustering by neighbourhood of residence (due to the sampling of women from suburbs) using the STATA version 10.1 statistical software package.

4.4. Results

4.4.1. Characteristics of the sample

The final sample consisted of 3,645 women. Table 4.1 presents the socio-demographic characteristics and risk of depression among participants. The mean age of participants was 35 years (SD = 8.15). Just over half of the women (53%) were classed as not overweight according to their BMI category. The majority of participants were born in Australia (89%) and were married/defacto (66%). A total of 1,874 (51%) reported their highest qualification as completing high school or an apprenticeship or certificate/diploma, with 972 (27%) having completed a
university or higher degree. Just under half reported a weekly household income of $1500 or less and the majority of women had children living at home (62%). A total of 406 (11%) women reported suffering from a long term illness/injury that prevented them from being physically active and a total of 1,328 (36%) participants were classified as being at risk of depression (according to the CES-D). Furthermore, it was found that those at risk of depression were more likely to have missing data on at least one covariate (e.g. age, BMI), and as mentioned in the methods section, those with missing covariate data were excluded from logistic regression analyses.
Table 4.1 Frequencies of socio-demographic characteristics amongst women living in socio-economically disadvantaged neighbourhoods (n=3,645)

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>N</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Age</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Under 25 yrs</td>
<td>608</td>
<td>17</td>
</tr>
<tr>
<td>25 to 29 yrs</td>
<td>503</td>
<td>14</td>
</tr>
<tr>
<td>30 to 34 yrs</td>
<td>538</td>
<td>15</td>
</tr>
<tr>
<td>35 to 39 yrs</td>
<td>777</td>
<td>21</td>
</tr>
<tr>
<td>40+ years</td>
<td>1219</td>
<td>33</td>
</tr>
<tr>
<td><strong>BMI category</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Not overweight (&lt;25)</td>
<td>1943</td>
<td>53</td>
</tr>
<tr>
<td>Overweight (25-29.9)</td>
<td>919</td>
<td>25</td>
</tr>
<tr>
<td>Obese (30+)</td>
<td>783</td>
<td>22</td>
</tr>
<tr>
<td><strong>Country of birth</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Australia</td>
<td>3243</td>
<td>89</td>
</tr>
<tr>
<td>Other</td>
<td>402</td>
<td>11</td>
</tr>
<tr>
<td><strong>Marital Status</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Married or defacto</td>
<td>2390</td>
<td>66</td>
</tr>
<tr>
<td>Separated widowed or divorced</td>
<td>311</td>
<td>8</td>
</tr>
<tr>
<td>Never married</td>
<td>944</td>
<td>26</td>
</tr>
<tr>
<td><strong>Highest Qualification</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Did not complete high school</td>
<td>799</td>
<td>22</td>
</tr>
<tr>
<td>High school/trade apprentice/certificate/diploma</td>
<td>1874</td>
<td>51</td>
</tr>
<tr>
<td>University or higher degree</td>
<td>972</td>
<td>27</td>
</tr>
</tbody>
</table>
### Household income

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>N</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>No income</td>
<td>21</td>
<td>&lt;1</td>
</tr>
<tr>
<td>$1-$119 per week</td>
<td>18</td>
<td>&lt;1</td>
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<tr>
<td>$120 - $299 per week</td>
<td>54</td>
<td>2</td>
</tr>
<tr>
<td>$300 - 499 per week</td>
<td>151</td>
<td>4</td>
</tr>
<tr>
<td>$500 - 699 per week</td>
<td>296</td>
<td>8</td>
</tr>
<tr>
<td>$700 - $999 per week</td>
<td>509</td>
<td>14</td>
</tr>
<tr>
<td>$1000 - $1499 per week</td>
<td>593</td>
<td>16</td>
</tr>
<tr>
<td>$1500 or more per week</td>
<td>632</td>
<td>17</td>
</tr>
<tr>
<td>Other</td>
<td>1371</td>
<td>38</td>
</tr>
</tbody>
</table>

### Employment status

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>N</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Working full-time</td>
<td>1409</td>
<td>39</td>
</tr>
<tr>
<td>Working part-time</td>
<td>1092</td>
<td>30</td>
</tr>
<tr>
<td>Unemployed/laid off</td>
<td>82</td>
<td>2</td>
</tr>
<tr>
<td>Keeping house/raise children</td>
<td>829</td>
<td>23</td>
</tr>
<tr>
<td>Studying full-time</td>
<td>224</td>
<td>6</td>
</tr>
<tr>
<td>Retired</td>
<td>9</td>
<td>&lt;1</td>
</tr>
</tbody>
</table>

### Children living at home (up to 18 yrs)

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>N</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>2261</td>
<td>62</td>
</tr>
<tr>
<td>No</td>
<td>1384</td>
<td>38</td>
</tr>
</tbody>
</table>

### Long term illness/injury?

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>N</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>406</td>
<td>11</td>
</tr>
<tr>
<td>No</td>
<td>3239</td>
<td>89</td>
</tr>
</tbody>
</table>

### At risk of depression

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>N</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Not at risk (&lt;10)</td>
<td>2317</td>
<td>64</td>
</tr>
<tr>
<td>At risk (≥10)</td>
<td>1328</td>
<td>36</td>
</tr>
</tbody>
</table>
Table 4.2 describes the mean duration per week of physical activity (within each domain) and sedentary behaviours reported by participants. Of the physical activity undertaken in leisure-time (LTPA), women spent more time walking than in other moderate- or vigorous-intensity physical activity. The mean duration of other moderate-intensity physical activity undertaken during leisure-time was just over 38 minutes per week. The mean duration of vigorous-intensity physical activity undertaken in leisure-time was just less than one hour per week. These relatively low mean amounts of physical activity are partly due to the large proportions of women reporting no moderate (n = 2,621) or vigorous (n = 2,392) physical activity in leisure-time (see Table 3.4).

In regards to work-related physical activity, women reported on average just over 5½ hours per week of walking, approximately 4 hours per week in moderate activity, and 2 per week in vigorous work-related physical activity. On average, women reported approximately 8 minutes per week in transport-related cycling, with a large proportion reporting no transport-related cycling (n = 3,273). Women reported just under 3 hours per week of walking for transport. They reported on average nearly 12 hours per week in domestic physical activity (across intensities). In total, women reported on average 28 hours per week (~4hr/day) of physical activity across all the domains and intensities that were assessed.

Participants reported just under 22 hours per week (~3hr/day) sitting at a computer and approximately 25 hours per week (~3.5hr/day) sitting watching television. On average, women reported 50½ hours per week sitting (~7hr/day)
and 44 hours per week (~6hr/day) total screen time (computer use and television viewing).

**Table 4.2** Mean hours per week and standard deviation (SD) of physical activity (PA) in various domains and sedentary behaviour among the 3,645 participants in the READI study.

<table>
<thead>
<tr>
<th>Domain</th>
<th>Intensity/type</th>
<th>Mean hours p/wk</th>
<th>SD (hours)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>LTPA</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Walking</td>
<td>1.89</td>
<td>2.83</td>
<td></td>
</tr>
<tr>
<td>Moderate</td>
<td>0.64</td>
<td>1.73</td>
<td></td>
</tr>
<tr>
<td>Vigorous</td>
<td>0.93</td>
<td>2.10</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>3.41</td>
<td>4.48</td>
<td></td>
</tr>
<tr>
<td><strong>Work PA</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Walking</td>
<td>5.55</td>
<td>9.67</td>
<td></td>
</tr>
<tr>
<td>Moderate</td>
<td>4.08</td>
<td>7.99</td>
<td></td>
</tr>
<tr>
<td>Vigorous</td>
<td>2.03</td>
<td>4.45</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>9.85</td>
<td>14.26</td>
<td></td>
</tr>
<tr>
<td><strong>Transport PA</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cycling</td>
<td>0.12</td>
<td>0.77</td>
<td></td>
</tr>
<tr>
<td>Walking</td>
<td>2.86</td>
<td>4.51</td>
<td></td>
</tr>
<tr>
<td>Total (walking/cycling)</td>
<td>2.96</td>
<td>4.55</td>
<td></td>
</tr>
<tr>
<td><strong>Domestic PA</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>11.82</td>
<td>12.68</td>
<td></td>
</tr>
<tr>
<td><strong>Total/Global (all domains)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>27.79</td>
<td>23.94</td>
<td></td>
</tr>
<tr>
<td><strong>Computer use</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>21.90</td>
<td>29.21</td>
<td></td>
</tr>
<tr>
<td><strong>TV viewing</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>24.99</td>
<td>24.82</td>
<td></td>
</tr>
<tr>
<td><strong>Screen time (TV + Computer)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>43.99</td>
<td>33.33</td>
<td></td>
</tr>
<tr>
<td><strong>Sitting Time</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>50.55</td>
<td>33.47</td>
<td></td>
</tr>
</tbody>
</table>

TV, television; PA, physical activity; LTPA, leisure-time physical activity; Sitting time variable includes sedentary behaviours such as sitting at a desk, visiting friends, reading, watching television and driving; p/wk, per week
4.4.2. Bivariable cross-tabulation analyses

Cross-tabulations were performed in order to determine the proportion of participants at risk of depression within each category of the physical activity and sedentary behaviour variables, and the significance of these associations was determined using the chi-square statistic.

4.4.2.1. Domain of physical activity

Table 4.3 shows the proportion of women at risk of depression according to participation in tertiles of physical activity in the previous week within each domain. Risk of depression was inversely associated with leisure-time physical activity duration. Of those in the bottom tertile of leisure-time physical activity (<40 mins p/wk), 44% were at risk of depression; while of those in the upper tertile (>3.4 hrs/wk in leisure-time physical activity), only 32% were at risk of depression. No other physical activity domains were associated with risk of depression, and nor was global physical activity participation.
Table 4.3 The proportion of women from chi-square analyses at risk of depression according to participation in tertiles of physical activity in the previous week within each domain.

<table>
<thead>
<tr>
<th>Domain</th>
<th>Category (p/week)</th>
<th>n</th>
<th>Not at risk of depression (%)</th>
<th>At risk of depression (%)</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>LTPA Total</strong></td>
<td>&lt;40 mins p/wk</td>
<td>1153</td>
<td>56</td>
<td>44</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td></td>
<td>41 mins-3.4 hrs p/wk</td>
<td>1145</td>
<td>67</td>
<td>33</td>
<td></td>
</tr>
<tr>
<td></td>
<td>&gt;3.4 hours p/wk</td>
<td>1226</td>
<td>68</td>
<td>32</td>
<td></td>
</tr>
<tr>
<td><strong>Work PA Total</strong></td>
<td>No work PA</td>
<td>1581</td>
<td>63</td>
<td>37</td>
<td>0.230</td>
</tr>
<tr>
<td></td>
<td>0.1-14.5 hours p/wk</td>
<td>951</td>
<td>66</td>
<td>34</td>
<td></td>
</tr>
<tr>
<td></td>
<td>&gt;14.5 hours p/wk</td>
<td>943</td>
<td>63</td>
<td>37</td>
<td></td>
</tr>
<tr>
<td><strong>Transport PA</strong></td>
<td>&lt;30 mins p/wk</td>
<td>1201</td>
<td>62</td>
<td>38</td>
<td>0.102</td>
</tr>
<tr>
<td>Total</td>
<td>30 mins-2.5 hours p/wk</td>
<td>1201</td>
<td>65</td>
<td>35</td>
<td></td>
</tr>
<tr>
<td></td>
<td>&gt;2.5 hours p/wk</td>
<td>1100</td>
<td>66</td>
<td>34</td>
<td></td>
</tr>
<tr>
<td><strong>Domestic PA</strong></td>
<td>&lt;3 hours p/wk</td>
<td>1095</td>
<td>63</td>
<td>37</td>
<td>0.506</td>
</tr>
<tr>
<td>Total</td>
<td>3-11.7 hours p/wk</td>
<td>1140</td>
<td>65</td>
<td>35</td>
<td></td>
</tr>
<tr>
<td></td>
<td>&gt;11.7 hours p/wk</td>
<td>1233</td>
<td>65</td>
<td>35</td>
<td></td>
</tr>
<tr>
<td><strong>Global PA</strong></td>
<td>&lt;11.5 hours p/wk</td>
<td>1055</td>
<td>64</td>
<td>36</td>
<td>0.132</td>
</tr>
<tr>
<td>(all domains)</td>
<td>11.5-32.3 hours p/wk</td>
<td>1060</td>
<td>67</td>
<td>33</td>
<td></td>
</tr>
<tr>
<td></td>
<td>&gt;32.3 hours p/wk</td>
<td>1108</td>
<td>63</td>
<td>37</td>
<td></td>
</tr>
</tbody>
</table>

PA, physical activity; LTPA, leisure-time physical activity; p/wk, per week
4.4.2.2. Leisure-time physical activity

Table 4.4 shows the proportion of women at risk of depression according to participation in leisure-time physical activity (walking, moderate-intensity, vigorous-intensity hrs/wk). The proportion of participants at risk of depression was lower among women who reported some (>0.1 hr/wk) weekly walking, moderate- or vigorous-intensity physical activity in leisure-time, regardless of whether they were in the middle or highest tertile.

**Table 4.4** The proportion of women from chi-square analyses at risk of depression according to participation in leisure-time physical activity (walking, moderate-intensity, vigorous-intensity hrs/wk)

<table>
<thead>
<tr>
<th>LTPA Intensity</th>
<th>Category (p/week)</th>
<th>n</th>
<th>Not at risk of depression (%)</th>
<th>At risk of depression (%)</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Walking</td>
<td>No LT walking</td>
<td>1376</td>
<td>58</td>
<td>42</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td></td>
<td>0.1-2 hours p/wk</td>
<td>1214</td>
<td>67</td>
<td>33</td>
<td></td>
</tr>
<tr>
<td></td>
<td>&gt;2 hours p/wk</td>
<td>1000</td>
<td>67</td>
<td>33</td>
<td></td>
</tr>
<tr>
<td>Moderate</td>
<td>No moderate LTPA</td>
<td>2621</td>
<td>62</td>
<td>38</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td></td>
<td>0.1-1.33 hours p/wk</td>
<td>431</td>
<td>72</td>
<td>28</td>
<td></td>
</tr>
<tr>
<td></td>
<td>&gt;1.33 hours p/wk</td>
<td>511</td>
<td>66</td>
<td>34</td>
<td></td>
</tr>
<tr>
<td>Vigorous</td>
<td>No vigorous LTPA</td>
<td>2392</td>
<td>61</td>
<td>39</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td></td>
<td>0.1-1.9 hours p/wk</td>
<td>562</td>
<td>67</td>
<td>33</td>
<td></td>
</tr>
<tr>
<td></td>
<td>&gt;1.9 hours p/wk</td>
<td>627</td>
<td>70</td>
<td>30</td>
<td></td>
</tr>
</tbody>
</table>

LTPA, leisure-time physical activity; p/wk, per week
4.4.2.3. Work-related physical activity

Table 4.5 shows the proportion of women at risk of depression according to participation in various intensities of work-related physical activity (walking, moderate-intensity, vigorous-intensity hrs/wk). The proportion of women at risk of depression was lower amongst those who reported 0.1-6 hours p/wk (middle tertile) of moderate-intensity activity, when compared to those in the bottom (no moderate-intensity work-related physical activity) and upper (>6 hours p/wk) tertiles. No association was found between either walking or vigorous-intensity work-related physical activity and risk of depression.

**Table 4.5** The proportion of women from chi-square analyses at risk of depression according to participation in work-related physical activity (walking, moderate-intensity, vigorous-intensity hrs/wk)

<table>
<thead>
<tr>
<th>Work PA Intensity</th>
<th>Category (p/week)</th>
<th>n</th>
<th>Not at risk of depression (%)</th>
<th>At risk of depression (%)</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Walking</strong></td>
<td>No walking at work</td>
<td>1951</td>
<td>63</td>
<td>37</td>
<td>0.129</td>
</tr>
<tr>
<td></td>
<td>0.1-8 hours p/wk</td>
<td>831</td>
<td>66</td>
<td>34</td>
<td></td>
</tr>
<tr>
<td></td>
<td>&gt;8 hours p/wk</td>
<td>774</td>
<td>62</td>
<td>38</td>
<td></td>
</tr>
<tr>
<td><strong>Moderate</strong></td>
<td>No moderate work PA</td>
<td>2143</td>
<td>64</td>
<td>36</td>
<td>0.015</td>
</tr>
<tr>
<td></td>
<td>0.1-6 hours p/wk</td>
<td>708</td>
<td>67</td>
<td>33</td>
<td></td>
</tr>
<tr>
<td></td>
<td>&gt;6 hours p/wk</td>
<td>694</td>
<td>60</td>
<td>40</td>
<td></td>
</tr>
<tr>
<td><strong>Vigorous</strong></td>
<td>No vigorous work PA</td>
<td>2569</td>
<td>64</td>
<td>36</td>
<td>0.905</td>
</tr>
<tr>
<td></td>
<td>0.1-5 hours p/wk</td>
<td>504</td>
<td>64</td>
<td>36</td>
<td></td>
</tr>
<tr>
<td></td>
<td>&gt;5 hours p/wk</td>
<td>510</td>
<td>63</td>
<td>37</td>
<td></td>
</tr>
</tbody>
</table>

PA, physical activity; p/wk, per week
4.4.2.4. Transport-related physical activity

Table 4.6 shows the proportion of women at risk of depression according to participation in walking and cycling for transport. While there was a trend towards an increased risk of depression amongst women reporting no cycling for transport compared to those who did cycle, no association was found between walking or cycling for transport and risk of depression.

<table>
<thead>
<tr>
<th>Transport PA Category (p/week)</th>
<th>n</th>
<th>Not at risk of depression (%)</th>
<th>At risk of depression (%)</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Walking</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;30 mins p/wk</td>
<td>1267</td>
<td>62</td>
<td>38</td>
<td>0.161</td>
</tr>
<tr>
<td>31-150 mins p/wk</td>
<td>1230</td>
<td>65</td>
<td>35</td>
<td></td>
</tr>
<tr>
<td>&gt;150 mins (2.5 hrs) p/wk</td>
<td>1068</td>
<td>65</td>
<td>35</td>
<td></td>
</tr>
<tr>
<td>Cycling</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No cycling for transport</td>
<td>3273</td>
<td>63</td>
<td>37</td>
<td>0.066</td>
</tr>
<tr>
<td>0.1-1 hour p/wk</td>
<td>169</td>
<td>69</td>
<td>31</td>
<td></td>
</tr>
<tr>
<td>&gt;1 hour p/wk</td>
<td>115</td>
<td>71</td>
<td>29</td>
<td></td>
</tr>
</tbody>
</table>

PA, physical activity; p/wk, per week

4.4.2.5. Social context of leisure-time physical activity

Table 4.7 shows the proportion of women at risk of depression according to the social context of leisure-time physical activity. The proportion of participants at risk of depression was higher among women who reported doing all leisure-time...
physical activity on their own (38%), when compared to those who reported doing some proportion of their leisure-time physical activity with someone else.

**Table 4.7** The proportion of women from chi-square analyses at risk of depression according to the social context of leisure-time physical activity

<table>
<thead>
<tr>
<th>Social PA Category</th>
<th>n</th>
<th>Not at risk of depression (%)</th>
<th>At risk of depression (%)</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>All LTPA was done on own</td>
<td>710</td>
<td>63</td>
<td>37</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Most (3/4) LTPA done on own</td>
<td>528</td>
<td>72</td>
<td>28</td>
<td></td>
</tr>
<tr>
<td>About ½ LTPA done on own</td>
<td>454</td>
<td>66</td>
<td>34</td>
<td></td>
</tr>
<tr>
<td>A little (1/4) done on own</td>
<td>381</td>
<td>69</td>
<td>31</td>
<td></td>
</tr>
<tr>
<td>All LTPA done with someone else</td>
<td>470</td>
<td>68</td>
<td>32</td>
<td></td>
</tr>
</tbody>
</table>

LTPA, leisure-time physical activity

**4.4.2.6. Sedentary behaviours**

Table 4.8 shows the proportion of women at risk of depression according to time spent participating in sedentary behaviours (computer time, television viewing, screen time, total sitting). Risk of depression was positively associated with television viewing time, screen time and sitting time. For example, of those in the bottom tertile (<13.7 hrs/wk) of television viewing time, 33% were at risk of depression; while of those in the upper tertile (>22.7 hrs/wk), 41% were at risk of depression. Similarly, for sitting time, of those in the bottom tertile (<30.7 hrs/wk), 33% were at risk of depression; while of those in the upper tertile (>54.5 hrs/wk) of sitting time, 41% were at risk of depression. In regards to total screen time (computer and television viewing), the proportion of participants at risk of
depression was higher among women who reported spending greater than 46.3 hours/wk (upper tertile) in screen time, when compared to those in the middle (23.5-46.3 hrs/wk) and bottom tertiles (<23.5 hrs/wk) of screen time. No significant association was found between time spent sitting at the computer and risk of depression.

**Table 4.8** The proportion of women from chi-square analyses at risk of depression according to participation in sedentary activities

<table>
<thead>
<tr>
<th>Sedentary behaviour</th>
<th>Category (p/week)</th>
<th>n</th>
<th>Not at risk of depression (%)</th>
<th>At risk of depression (%)</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Computer time</strong></td>
<td>&lt;4.75 hours p/wk</td>
<td>1110</td>
<td>66</td>
<td>34</td>
<td>0.094</td>
</tr>
<tr>
<td></td>
<td>4.75-21.5 hours p/wk</td>
<td>1127</td>
<td>64</td>
<td>36</td>
<td></td>
</tr>
<tr>
<td></td>
<td>&gt;21.5 hours p/wk</td>
<td>1173</td>
<td>61</td>
<td>39</td>
<td></td>
</tr>
<tr>
<td><strong>TV viewing</strong></td>
<td>&lt;13.7 hours p/wk</td>
<td>1152</td>
<td>67</td>
<td>33</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td></td>
<td>13.7-22.7 hours p/wk</td>
<td>1196</td>
<td>65</td>
<td>35</td>
<td></td>
</tr>
<tr>
<td></td>
<td>&gt;22.7 hours p/wk</td>
<td>1207</td>
<td>59</td>
<td>41</td>
<td></td>
</tr>
<tr>
<td><strong>Screen time</strong></td>
<td>&lt;23.5 hours p/wk</td>
<td>1125</td>
<td>68</td>
<td>32</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td></td>
<td>23.5-46.3 hours p/wk</td>
<td>1109</td>
<td>63</td>
<td>37</td>
<td></td>
</tr>
<tr>
<td></td>
<td>&gt;46.3 hours p/wk</td>
<td>1149</td>
<td>60</td>
<td>40</td>
<td></td>
</tr>
<tr>
<td><strong>Total sitting time</strong></td>
<td>&lt;30.7 hours p/wk</td>
<td>1162</td>
<td>67</td>
<td>33</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td></td>
<td>30.7-54.5 hours p/wk</td>
<td>1171</td>
<td>66</td>
<td>34</td>
<td></td>
</tr>
<tr>
<td></td>
<td>&gt;54.5 hours p/wk</td>
<td>1198</td>
<td>59</td>
<td>41</td>
<td></td>
</tr>
</tbody>
</table>

*TV, Television ; p/wk, per week*
4.4.3. Bivariable and multivariable logistic regression analyses

Logistic regression analyses were performed to determine the odds ratios and 95% confidence intervals for risk of depression according to the physical activity and sedentary behaviour variables. Since age, BMI, marital status, physical health/injury, household income, education, employment status, country of birth and children living at home were found to be significantly bivariately associated with risk of depression amongst women, multivariable analyses subsequently adjusted for these variables. Both the crude (bivariable) and adjusted (multivariable) odds ratios are presented in the tables.

4.4.3.1. Domain of physical activity

Table 4.9 shows the crude and adjusted odds ratios and 95% confidence intervals (CI) from logistic regression models predicting odds of risk of depression according to duration of physical activity (hrs/wk) within each domain. The bivariable results showed that compared to those in the lowest tertile (reporting less than 40 minutes leisure-time physical activity per week), those in the middle tertile (reporting 41 minutes-3.4 hours per week were) 37% less likely to be at risk of depression, while those in the highest tertile (reporting more than 3.4 hours of leisure-time physical activity) were 39% less likely to be at risk of depression. Similarly, the multivariable results showed that compared to those in the lowest tertile (reporting less than 40 minutes leisure-time physical activity per week), those in the middle tertile (reporting between 41 minutes and 3.4 hours per week) were 33% less likely to be at risk of depression, while those in the highest tertile
(reporting more than 3.4 hours leisure-time physical activity per week) were 35% less likely to be at risk of depression.

The bivariable results showed that compared to those who reported no transport-related physical activity per week (lowest tertile), those who reported greater than 2.5 hours per week (highest tertile) were 16% less likely to be at risk of depression. Similarly, the multivariable model showed that compared to those who reported no transport-related physical activity per week (lowest tertile), those who reported greater than 2.5 hours per week (highest tertile) were 18% less likely to be at risk of depression. No associations were found between risk of depression and total work-related, domestic or global physical activity in either the bivariable and multivariable logistic regression analyses.
Table 4.9 Crude and adjusted* odds ratios and 95% confidence intervals (CI) from logistic regression model predicting odds of risk of depression according to tertiles of physical activity within each domain†

<table>
<thead>
<tr>
<th>Domain (Total)</th>
<th>Category (p/week)</th>
<th>Crude odds ratio</th>
<th>95% CI</th>
<th>P</th>
<th>Adjusted* odds ratio</th>
<th>Adjusted* 95% CI</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>LTPA</td>
<td>&lt;40 mins p/wk</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
</tr>
<tr>
<td></td>
<td>41 mins-3.4 hrs p/wk</td>
<td>0.63</td>
<td>0.54-0.75</td>
<td>&lt;0.001</td>
<td>0.67</td>
<td>0.57-0.80</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td></td>
<td>&gt;3.4 hours p/wk</td>
<td>0.61</td>
<td>0.53-0.71</td>
<td>&lt;0.001</td>
<td>0.65</td>
<td>0.56-0.76</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Work PA</td>
<td>No work PA</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
</tr>
<tr>
<td></td>
<td>0.1-14.5 hours p/wk</td>
<td>0.87</td>
<td>0.73-1.03</td>
<td>0.109</td>
<td>0.94</td>
<td>0.78-1.13</td>
<td>0.493</td>
</tr>
<tr>
<td></td>
<td>&gt;14.5 hours p/wk</td>
<td>0.99</td>
<td>0.86-1.15</td>
<td>0.937</td>
<td>0.95</td>
<td>0.80-1.13</td>
<td>0.583</td>
</tr>
<tr>
<td>Transport PA</td>
<td>&lt;30 mins p/wk</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
</tr>
<tr>
<td></td>
<td>30 mins-2.5 hours p/wk</td>
<td>0.87</td>
<td>0.74-1.02</td>
<td>0.094</td>
<td>0.87</td>
<td>0.74-1.03</td>
<td>0.108</td>
</tr>
<tr>
<td></td>
<td>&gt;2.5 hours p/wk</td>
<td>0.84</td>
<td>0.71-1.00</td>
<td>0.044</td>
<td>0.82</td>
<td>0.69-0.98</td>
<td>0.026</td>
</tr>
<tr>
<td>Domestic PA</td>
<td>&lt;3 hours p/wk</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
</tr>
<tr>
<td></td>
<td>3-11.7 hours p/wk</td>
<td>0.91</td>
<td>0.76-1.09</td>
<td>0.323</td>
<td>0.96</td>
<td>0.80-1.15</td>
<td>0.675</td>
</tr>
<tr>
<td></td>
<td>&gt;11.7 hours p/wk</td>
<td>0.92</td>
<td>0.77-1.09</td>
<td>0.336</td>
<td>0.96</td>
<td>0.79-1.17</td>
<td>0.716</td>
</tr>
<tr>
<td>Global PA</td>
<td>&lt;11.5 hours p/wk</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
</tr>
<tr>
<td>(all domains)</td>
<td>11.5-32.3 hours p/wk</td>
<td>0.88</td>
<td>0.75-1.04</td>
<td>0.143</td>
<td>0.88</td>
<td>0.75-1.04</td>
<td>0.148</td>
</tr>
<tr>
<td></td>
<td>&gt;32.3 hours p/wk</td>
<td>1.05</td>
<td>0.89-1.26</td>
<td>0.548</td>
<td>0.99</td>
<td>0.83-1.19</td>
<td>0.944</td>
</tr>
</tbody>
</table>

*Adjusted for age, BMI, marital status, physical health/injury, household income, education, employment status, children living at home, country of birth
† Both models adjusted for clustering by neighbourhood
p/wk, per week;
4.4.3.2. Intensities of leisure-time physical activity

Table 4.10 shows the crude and adjusted odds ratios and 95% confidence intervals (CI) from logistic regression models predicting odds of risk of depression according to the duration of different intensities of leisure-time physical activity (hrs/wk). The bivariable results predicting odds of risk of depression according to walking duration showed that compared with those in the bottom tertile (reporting no walking), those in the middle tertile (reporting between 0.1-2 hours per week) were 33% less likely to be at risk of depression, whilst those in the highest tertile (reporting greater than 2 hours per week) were 31% less likely to be at risk of depression. These associations remained significant in the multivariable models. Compared with those in the bottom tertile (reporting no walking), those in the middle tertile (reporting between 0.1-2 hours per week) and highest tertile (reporting greater than 2 hours per week) were 28% less likely to be at risk of depression.

Before adjusting for confounders, women in the middle tertile of moderate-intensity leisure-time physical activity (reporting between 0.1-1.33 hours per week) were 37% less likely to be at risk of depression compared to women in the bottom tertile (reporting no moderate-intensity leisure-time physical activity). Similarly, the multivariable model showed that women in the middle tertile (reporting between 0.1-1.33 hours of moderate-intensity leisure-time physical activity per week) were 33% less likely to be at risk of depression compared to
women in the bottom tertile (reporting no moderate-intensity leisure-time physical activity).

The bivariable results for vigorous-intensity physical activity showed that compared with those in the bottom tertile of vigorous leisure-time physical activity (reporting no vigorous leisure-time physical activity), those in the middle tertile (reporting between 0.1-1.9 hours per week) were 24% less likely to be at risk of depression. However, this association was no longer significant in the multivariable model. Compared with those in the bottom tertile (reporting no vigorous leisure-time physical activity), the bivariable results showed that those in the highest tertile (reporting more than 1.9 hours per week) were 35% less likely to be at risk of depression. Similarly, in the multivariable model, it was found that compared with those in the bottom tertile (reporting no vigorous leisure-time physical activity), those in the highest tertile (reporting more than 1.9 hours per week) were 31% less likely to be at risk of depression.
Table 4.10 Crude and adjusted* odds ratios and 95% confidence intervals (CI) from logistic regression model predicting odds of risk of depression according to duration of different intensities of leisure-time physical activity (hrs/wk) †

<table>
<thead>
<tr>
<th>LTPA Category (hrs/wk)</th>
<th>Crude odds ratio</th>
<th>95% CI</th>
<th>P</th>
<th>Adjusted* odds ratio</th>
<th>Adjusted* 95% CI</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Walking</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No LT walking</td>
<td>1.00</td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0.1-2 hours p/wk</td>
<td>0.67</td>
<td>0.58-0.78</td>
<td>&lt;0.001</td>
<td>0.72</td>
<td>0.62-0.84</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>&gt;2 hours p/wk</td>
<td>0.69</td>
<td>0.59-0.81</td>
<td>&lt;0.001</td>
<td>0.72</td>
<td>0.61-0.84</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Moderate</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No moderate LTPA</td>
<td>1.00</td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0.1-1.33 hours p/wk</td>
<td>0.63</td>
<td>0.51-0.77</td>
<td>&lt;0.001</td>
<td>0.67</td>
<td>0.54-0.84</td>
<td>0.001</td>
</tr>
<tr>
<td>&gt;1.33 hours p/wk</td>
<td>0.83</td>
<td>0.68-1.02</td>
<td>0.076</td>
<td>0.89</td>
<td>0.72-1.11</td>
<td>0.318</td>
</tr>
<tr>
<td>Vigorous</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No vigorous LTPA</td>
<td>1.00</td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0.1-1.9 hours p/wk</td>
<td>0.76</td>
<td>0.63-0.92</td>
<td>0.005</td>
<td>0.85</td>
<td>0.70-1.04</td>
<td>0.118</td>
</tr>
<tr>
<td>&gt;1.9 hours p/wk</td>
<td>0.65</td>
<td>0.54-0.79</td>
<td>&lt;0.001</td>
<td>0.69</td>
<td>0.56-0.85</td>
<td>&lt;0.001</td>
</tr>
</tbody>
</table>

*Adjusted for age, BMI, marital status, physical health/injury, household income, education, employment status, children living at home, country of birth
† Both models adjusted for clustering by neighbourhood

4.4.3.3. Intensities of work-related physical activity

Table 4.11 shows the crude and adjusted odds ratios and 95% confidence intervals (CI) from logistic regression models predicting odds of risk of depression according to duration of different intensities of work-related physical activity (hrs/wk). The bivariable results showed that compared with women in the bottom tertile of moderate-intensity work-related physical activity (reporting no moderate-intensity work-related physical activity), those in the highest tertile (reporting greater than 6 hours per week) were 17% more likely to be at risk of depression. However, this was no longer significant in the multivariable model.
There were no other significant associations between intensity of work-related physical activity and risk of depression.

**Table 4.11** Crude and adjusted* odds ratios and 95% confidence intervals (CI) from logistic regression model predicting odds of risk of depression according to duration of different intensities of work-related physical activity (hrs/wk).†

<table>
<thead>
<tr>
<th>Work PA Category</th>
<th>Crude odds ratio</th>
<th>95% CI</th>
<th>P</th>
<th>Adjusted* odds ratio</th>
<th>Adjusted* 95% CI</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Walking</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No walking at work</td>
<td>1.00</td>
<td>1.00</td>
<td></td>
<td>1.00</td>
<td>1.00</td>
<td></td>
</tr>
<tr>
<td>0.1-8 hours p/wk</td>
<td>0.87</td>
<td>0.74-1.03</td>
<td>0.104</td>
<td>0.92</td>
<td>0.77-1.10</td>
<td>0.373</td>
</tr>
<tr>
<td>&gt;8 hours p/wk</td>
<td>1.06</td>
<td>0.91-1.24</td>
<td>0.419</td>
<td>1.05</td>
<td>0.88-1.25</td>
<td>0.596</td>
</tr>
<tr>
<td>Moderate</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No moderate work PA</td>
<td>1.00</td>
<td>1.00</td>
<td></td>
<td>1.00</td>
<td>1.00</td>
<td></td>
</tr>
<tr>
<td>0.1-6 hours p/wk</td>
<td>0.85</td>
<td>0.72-1.00</td>
<td>0.055</td>
<td>0.86</td>
<td>0.72-1.03</td>
<td>0.098</td>
</tr>
<tr>
<td>&gt;6 hours p/wk</td>
<td>1.17</td>
<td>1.01-1.36</td>
<td>0.039</td>
<td>1.10</td>
<td>0.93-1.30</td>
<td>0.281</td>
</tr>
<tr>
<td>Vigorous</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No vigorous work PA</td>
<td>1.00</td>
<td>1.00</td>
<td></td>
<td>1.00</td>
<td>1.00</td>
<td></td>
</tr>
<tr>
<td>0.1-5 hours p/wk</td>
<td>0.97</td>
<td>0.83-1.15</td>
<td>0.756</td>
<td>0.99</td>
<td>0.83-1.18</td>
<td>0.916</td>
</tr>
<tr>
<td>&gt;5 hours p/wk</td>
<td>1.03</td>
<td>0.86-1.23</td>
<td>0.724</td>
<td>0.94</td>
<td>0.77-1.15</td>
<td>0.535</td>
</tr>
</tbody>
</table>

*Adjusted for age, BMI, marital status, physical health/injury, household income, education, employment status, children living at home, country of birth
† Both models adjusted for clustering by neighbourhood p/wk, per week

**4.4.3.4. Transport-related physical activity**

Table 4.12 shows the crude and adjusted odds ratios and 95% confidence intervals (CI) from logistic regression models predicting odds of risk of depression according to tertiles of transport-related walking and cycling in the previous week. The multivariable results for transport-related walking showed that compared with those in the lowest tertile (reporting less than 30 minutes per week
of walking for transport), those in the highest tertile (reporting greater than 150 minutes per week) were 18% less likely to be at risk of depression. No associations were found between cycling for transport and risk of depression.

**Table 4.12** Crude and adjusted* odds ratios and 95% confidence intervals (CI) from logistic regression model predicting odds of risk of depression according to tertiles of transport-related walking and cycling in the previous week †

<table>
<thead>
<tr>
<th>Transport PA Category (p/week)</th>
<th>Crude odds ratio</th>
<th>95% CI</th>
<th>P</th>
<th>Adjusted* odds ratio</th>
<th>Adjusted* 95% CI</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Walking</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;30 mins p/wk</td>
<td>1.00</td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>31-150 mins p/wk</td>
<td>0.88</td>
<td>0.76-1.03</td>
<td>0.108</td>
<td>0.88</td>
<td>0.75-1.03</td>
<td>0.106</td>
</tr>
<tr>
<td>&gt;150 mins (2.5 hrs) p/wk</td>
<td>0.86</td>
<td>0.73-1.02</td>
<td>0.077</td>
<td>0.82</td>
<td>0.69-0.98</td>
<td>0.027</td>
</tr>
<tr>
<td>Cycling</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No cycling for transport</td>
<td>1.00</td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0.1-1 hour p/wk</td>
<td>0.76</td>
<td>0.54-1.08</td>
<td>0.125</td>
<td>0.87</td>
<td>0.61-1.26</td>
<td>0.467</td>
</tr>
<tr>
<td>&gt;1 hour p/wk</td>
<td>0.69</td>
<td>0.46-1.04</td>
<td>0.076</td>
<td>0.76</td>
<td>0.51-1.13</td>
<td>0.169</td>
</tr>
</tbody>
</table>

*Adjusted for age, BMI, marital status, physical health/injury, household income, education, employment status, children living at home, country of birth
† Both models adjusted for clustering by neighbourhood
p/wk, per week

**4.4.3.5. Social context of leisure-time physical activity**

Table 4.13 shows the crude and adjusted odds ratios and 95% confidence intervals (CI) from logistic regression models predicting odds of risk of depression according to the social context of leisure-time physical activity. In both crude and adjusted models, it was found that compared with those who reported doing all leisure-time physical activity on their own, those who reported doing about ⅓ (most) leisure-time physical activity alone (i.e. about a quarter with others) were less likely to be at risk of depression (33% and 31% respectively). There were no
other significant associations between the social context of physical activity and risk of depression. However, although results only approached significance in crude ($p = 0.050$) and adjusted ($p = 0.062$) models, women who reported undertaking $\frac{1}{4}$ (a little) of their leisure-time physical activity on their own were 25% less likely to be at risk of depression compared with women who reported undertaking all their leisure-time physical activity on their own.

Table 4.13 Crude and adjusted* odds ratios and 95% confidence intervals (CI) from logistic regression model predicting odds of risk of depression according the social context of leisure-time physical activity†

<table>
<thead>
<tr>
<th>Social LTPA category</th>
<th>Crude odds ratio</th>
<th>95% CI</th>
<th>P</th>
<th>Adjusted* odds ratio</th>
<th>Adjusted* 95% CI</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>All LTPA done on own</td>
<td>1.00</td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Most (3/4) done on own</td>
<td>0.67</td>
<td>0.53-0.86</td>
<td>0.001</td>
<td>0.69</td>
<td>0.53-0.89</td>
<td>0.004</td>
</tr>
<tr>
<td>Half done on own</td>
<td>0.86</td>
<td>0.65-1.14</td>
<td>0.288</td>
<td>0.87</td>
<td>0.66-1.15</td>
<td>0.330</td>
</tr>
<tr>
<td>A little (1/4) done on own</td>
<td>0.75</td>
<td>0.56-1.00</td>
<td>0.050</td>
<td>0.75</td>
<td>0.56-1.01</td>
<td>0.062</td>
</tr>
<tr>
<td>All LTPA with someone</td>
<td>0.81</td>
<td>0.64-1.03</td>
<td>0.082</td>
<td>0.86</td>
<td>0.67-1.11</td>
<td>0.253</td>
</tr>
</tbody>
</table>

*Adjusted for age, BMI, marital status, physical health/injury, household income, education, employment status, children living at home, country of birth
† Both models adjusted for clustering by neighbourhood

4.4.3.6. Sedentary behaviours

Table 4.14 shows the crude and adjusted odds ratios and 95% confidence intervals (CI) from logistic regression models predicting odds of risk of depression according to the duration of various sedentary behaviours (computer time, television viewing, screen time, total sitting time) (hrs/wk). The bivariable results for television viewing showed that women in the bottom tertile of television viewing (reporting less than 13.7 hours of television viewing per week) were 40% more likely than those in the highest tertile (reporting more than 22.7 hours per
week) to be at risk of depression. However, results were no longer significant in the multivariable model.

The bivariable results for computer time showed that compared with women in the bottom tertile of computer time (reporting less than 4.75 hours of computer time per week), those in the highest tertile (reporting greater than 21.5 hours per week) were 20% more likely to be at risk of depression. Similarly, the multivariable results showed that compared to women in the bottom tertile (reporting less than 4.75 hours computer time per week), those in the highest tertile (reporting more than 21.5 hours) were 35% more likely to be at risk of depression.

The bivariable results for screen time showed that compared with women in the bottom tertile of screen time (reporting less than 23.5 hours of screen time per week), those in the middle tertile (reporting between 23.5-46.3 hours per week) were 21% more likely to be at risk of depression. This association was not longer significant in the multivariable model. However, both the bivariable and multivariable results for screen time showed that, compared with women in the bottom tertile (reporting less than 23.5 hours of screen time per week), those in the highest tertile (reporting more than 46.3 hours per week) were more likely to be at risk of depression (crude OR = 1.41, p = <0.001 and adjusted OR = 1.31, p = 0.004).
The bivariable results showed that compared with women in the bottom tertile of total sitting time (reporting less than 30.7 hours per week), those in the highest tertile (reporting more than 54.5 hours sitting per week) were 40% more likely to be at risk of depression. Similarly, the multivariable results show that compared with women in the bottom tertile (reporting less than 30.7 hours per week of sitting time), those who in the highest tertile (reporting more than 54.5 hours sitting per week) were 28% more likely to be at risk of depression.
Table 4.14 Crude and adjusted* odds ratios and 95% confidence intervals (CI) from logistic regression model predicting odds of risk of depression according the duration of various sedentary behaviours (hrs/wk)†

<table>
<thead>
<tr>
<th>Sedentary behaviour</th>
<th>Category (p/week)</th>
<th>Crude OR</th>
<th>95% CI</th>
<th>P</th>
<th>Adjusted* OR</th>
<th>Adjusted* 95% CI</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>TV viewing</td>
<td>&lt;13.7 hours p/wk</td>
<td>1.00</td>
<td></td>
<td></td>
<td>1.00</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>13.7-22.7 hours p/wk</td>
<td>1.09</td>
<td>0.91-1.29</td>
<td>0.342</td>
<td>1.05</td>
<td>0.87-1.26</td>
<td>0.626</td>
</tr>
<tr>
<td></td>
<td>&gt;22.7 hours p/wk</td>
<td>1.40</td>
<td>1.18-1.67</td>
<td>&lt;0.001</td>
<td>1.19</td>
<td>0.99-1.43</td>
<td>0.059</td>
</tr>
<tr>
<td>Computer time</td>
<td>&lt;4.75 hours p/wk</td>
<td>1.00</td>
<td></td>
<td></td>
<td>1.00</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>4.75-21.5 hours p/wk</td>
<td>1.06</td>
<td>0.89-1.27</td>
<td>0.484</td>
<td>1.12</td>
<td>0.93-1.36</td>
<td>0.218</td>
</tr>
<tr>
<td></td>
<td>&gt;21.5 hours p/wk</td>
<td>1.20</td>
<td>1.02-1.41</td>
<td>0.025</td>
<td>1.35</td>
<td>1.14-1.60</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Screen time</td>
<td>&lt;23.5 hours p/wk</td>
<td>1.00</td>
<td></td>
<td></td>
<td>1.00</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>23.5-46.3 hours p/wk</td>
<td>1.21</td>
<td>1.02-1.44</td>
<td>0.030</td>
<td>1.13</td>
<td>0.93-1.37</td>
<td>0.206</td>
</tr>
<tr>
<td></td>
<td>&gt;46.3 hours p/wk</td>
<td>1.41</td>
<td>1.20-1.66</td>
<td>&lt;0.001</td>
<td>1.31</td>
<td>1.09-1.58</td>
<td>0.004</td>
</tr>
<tr>
<td>Total sitting time</td>
<td>&lt;30.7 hours p/wk</td>
<td>1.00</td>
<td></td>
<td></td>
<td>1.00</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>30.7-54.5 hours p/wk</td>
<td>1.04</td>
<td>0.87-1.26</td>
<td>0.657</td>
<td>0.95</td>
<td>0.78-1.14</td>
<td>0.4566</td>
</tr>
<tr>
<td></td>
<td>&gt;54.5 hours p/wk</td>
<td>1.40</td>
<td>1.19-1.65</td>
<td>&lt;0.001</td>
<td>1.28</td>
<td>1.06-1.53</td>
<td>0.009</td>
</tr>
</tbody>
</table>

*Adjusted for age, BMI, marital status, physical health/injury, household income, education, employment status, children living at home, country of birth
† Both models adjusted for clustering by neighbourhood.

4.4.3.7. Inter-relationship between sedentary behaviour, physical activity and risk of depression

Figure 4.1 shows the adjusted odds ratios and 95% confidence intervals (CI) from logistic regression models examining the interaction between weekly duration of
leisure-time physical activity (low PA = <11.5 hours per week; mid PA = 11.5-32.3 hours per week; High PA = >32.3 hours per wk) and total sitting time (SB: low SB = <30.7 hours per week; mid SB = 30.7-54.5 hours per week; High SB = >54.5 hours per week) predicting risk of depression. Results showed no significant interactions between leisure-time physical activity, sedentary behaviour (total sitting time) and risk of depression.

**Figure 4.1** Adjusted* odds ratios and 95% confidence intervals (CI) from logistic regression models examining the interaction between weekly duration of leisure-time physical activity and total sitting time (SB) predicting risk of depression†.

*Adjusted for age, BMI, marital status, physical health/injury, household income, education, employment status, children living at home, country of birth
† Both models adjusted for clustering by neighbourhood.

### 4.5. Discussion

The aim of the current study was to examine the associations between components of physical activity (e.g. domain and social context), sedentary behaviours and risk of depression amongst women living in socio-economically disadvantaged areas using cross-sectional data from a large population-based
cohort of women aged 18-46 and living in low SEP suburbs in Victoria. Furthermore, this study aimed to examine interactions between physical activity, sedentary behaviour and risk of depression. Based on the review of the literature, it was hypothesised that leisure-time physical activity (of all intensities) would be more strongly associated with lower risk of depression than activity undertaken in other domains (transport-, work-related, domestic). Further, accompanied activities (e.g. group exercise classes) were hypothesized to be more strongly associated with lower risk of depression than physical activities undertaken alone, and that time spent undertaking sedentary activities such as television viewing would be associated with a greater risk of depression. Finally, it was hypothesised that there would be an interaction between physical activity, sedentary behaviour and risk of depression, such that the link between sedentary behaviour and risk of depression would be stronger amongst less physically active women than more physically active women.

**Associations between domain of physical activity and risk of depression**

The current study found that women who reported participating in greater amounts of leisure-time physical activity (>40 mins p/wk) were less likely to be at risk of depression than those who reported undertaking less than this. Further, results showed an inverse relationship with risk of depression when examining the duration of leisure-time physical activity undertaken in each intensity (i.e. walking, moderate, vigorous). These findings suggest that greater doses of leisure-time physical activity may reduce the risk of depression, or alternatively people experiencing depressive symptoms consequently spend less time in
leisure-time physical activity. The findings of the current study are supported by previous literature which has suggested that leisure-time physical activity is associated with a reduced likelihood of risk of depression in women (Mutrie & Hannah, 2007; Teychenne, Ball, & Salmon, 2008a) as well as in the general population (Pitsavos et al., 2005; Stephens, 1988).

The findings of this study indicate that undertaking a high dose of transport-related physical activity is associated with lower risk of depressive symptoms, as women who reported more than 2.5 hours per week of total transport-related physical activity (e.g. walking and cycling) were at a lower risk of depression compared to those who reported lower doses. However, when examined according to each transport-related activity separately (cycling and walking), only transport-related walking was associated with a reduced likelihood of depression, with women who reported spending greater than 2.5 hours per week walking for transport being at a lower risk of depression when compared to women reporting less than half an hour per week. This suggests it may be the type of physical activity used for transport that is important in reducing the risk of depression. However, the lack of association observed between transport-related cycling and risk of depression may be due to the smaller number of women reporting cycling for transport (n=315), resulting in reduced power to detect associations. The non-significant trend in associations for transport and risk of depression supports this contention. This finding is in contrast to those of two previous studies that specifically examined and found no association between transport-related physical activity and risk of depression (McKercher et al., 2009; Teychenne, Ball,
& Salmon, 2008a). However, the sample sizes of both previous studies (McKercher et al., 2009; Teychenne, Ball, & Salmon, 2008a) were much smaller than that of the current study, perhaps reducing the power to detect smaller associations.

Consistent with previous studies (Mutrie & Hannah, 2007; Teychenne, Ball, & Salmon, 2008a), no association was found between any intensity of work-related physical activity and risk of depression in the present study. This finding suggests that it may be the type/mode of physical activity, rather than the dose alone (i.e. intensity and duration), that is important in determining the relationship between physical activity and risk of depressive symptoms. However, in contrast to these findings, one previous study found that greater durations of work-related physical activity were related to an increased risk of depression in young women (McKercher et al., 2009). Thus, further studies are needed to assess the association between work-related physical activity and risk of depression.

In the current study, no association was found between total domestic physical activity and risk of depression. This finding may be due to women’s lack of enjoyment or control when participating in domestic physical activity. These results are consistent with previous studies (McKercher et al., 2009; Teychenne, Ball, & Salmon, 2008a) that also found no association between domestic physical activity and risk of depression in women. However, in contrast, one previous study (Mutrie & Hannah, 2007) found a positive relationship between vigorous-intensity domestic physical activity and risk of depression; that is, the greater the
time spent undertaking vigorous domestic physical activity, the greater the odds of depression. As the current study did not examine domestic physical activity according to intensity, this precluded an examination of the specific associations.

**Social context of physical activity**

The social context of physical activity was found to be associated with risk of depression in the current study, although the association was not linear and only held for those women reporting undertaking one-quarter of their leisure-time PA with someone else. The finding that reduced risk of depression was associated with doing about one-quarter of physical activity with someone else, but not 50% or more, is not easily explained. This may have been related to the particular categories of physical activity analysed. However, in further investigation of this association, we re-categorized social context as: All leisure-time PA done on own (reference category); more than half (but not all) leisure-time PA done on own; and less than half leisure-time PA done on own. Results showed no significant associations between either one of those categories and risk of depression (data not shown). Further investigation of this non-linear association is required.

The current study suggested that additional mental health benefits may come from undertaking some leisure-time PA with someone else, yet not all physical activity with others may be associated with a lower risk of depression. This is consistent with our previous findings from the only other cross-sectional study that has examined the association between the social context of physical activity and risk of depression (Teychenne, Ball, & Salmon, 2008a). That study we found that
being active with a family member was associated with a lower risk of depression, yet being active with a friend was not. Conversely, the present findings may also suggest that women at risk of depression prefer to participate in physical activity by themselves, since social withdrawal is a symptom of minor depression (Hamilton, 1960). Since social support is widely known to be linked to lower levels of depression (Nasser & Overholser, 2005), the social context of physical activity may be an important component in the relationship between physical activity and depression. This findings further supports the preliminary recommendations for promoting physical activity to reduce/manage depression in adults, which suggest that physical activity should be performed in groups (National Institute of Clinical Excellence, 2009).

**Hypotheses explaining the association between physical activity and depression**

A number of hypotheses have been proposed to explain inverse association between physical activity and depression. While the present study did not aim to test these hypotheses explicitly, findings can help shed light on which of these may be more plausible. For example, physiological hypotheses that have been suggested to explain the inverse association between physical activity and depression include the endorphin hypothesis, which suggests that physical activity produces endorphin secretion, which in turn reduces pain and produces feelings of euphoria (Paluska & Schwenk, 2000). However, the production of endorphins requires a high exercise intensity (Fox, 1999). In the current study, walking for leisure was inversely associated with risk of depression. This is more consistent
with other hypotheses, such as the serotonin hypothesis (Ernst et al., 2006). The serotonin hypothesis suggests that exercise may reduce depression by increasing the synthesis of serotonin (Chaouloff, 1997; Soares, Naffah-Mazzacoratti, & Cavalheiro, 1994), a neurotransmitter found in the brain which regulates mood and stress (McAllister-Williams, Ferrier, & Young, 1998). Furthermore, spending time outdoors (in natural light) may provide additional mental health benefits when undertaking physical activity as exposure to light has been found to increase serotonin synthesis (Young, 2007). Present findings cannot support or refute this as the location of the activity (indoors or out) was not assessed in each case.

Non-physiological hypotheses may also play a role in explaining the inverse association between physical activity and depression. For example, physical activity may provide distraction effects, by which improvements in mental well-being following exercise may be due to the diversion of negative thoughts during the activity (Greist et al., 1979). In particular, leisure-time and transport-related physical activity may allow one to be distracted from stressful thoughts and/or activities (e.g. the stressful commute to work). Alternatively, improvements following physical activity may be attributed to the sense of mastery and success derived from achieving goals (Greist et al., 1979).

The social interaction hypothesis posits that the improvements in mental health following exercise are at least partly related to the mutual support and social relationships that are provided when participating in physical activity or the social
interaction associated with physical activity (Ransford, 1982). The current study was able to provide insights which were generally consistent with the social interaction hypothesis, as women who reported undertaking some leisure-time physical activity with someone else were less likely to be at risk of depression than those who reported undertaking all their leisure-time physical activity on their own. Since the current study was not designed to test the underlying mechanisms linking physical activity and risk of depression, further studies, particularly intervention studies, are needed to test the proposed physiological and non-physiological hypotheses.

**Associations between sedentary behaviours and risk of depression**

The current study found that time spent undertaking sedentary behaviour (computer, screen and total sitting time) was associated with an increased risk of depression. More specifically, it found that greater doses of computer use, sitting and screen time (i.e. in the highest tertile of this study) were associated with an increased risk of depressive symptoms. This is consistent with findings of several previous studies (cross-sectional, longitudinal and intervention) that assessed sedentary behaviour in terms of computer/internet use (Kraut et al., 1998; Thomee et al., 2007) and overall sitting time (Sanchez et al., 2008), suggesting that greater doses of sedentary behaviour increase the risk of depression, or alternatively that people experiencing depressive symptoms consequently spend greater amounts of time in those sedentary activities. However, in contrast to previous studies (Dittmar, 1994; Kleinke, 1988), the association between television viewing and risk of depression in this study did not quite reach statistical significance.
Although results showed a trend in the expected direction, a possible explanation for the lack of significant relationship could be due to the potential limitations of self-report measures used for both television viewing and depressive symptoms, which may have included women reporting socially desirable responses (e.g. under-reporting time spent watching television or depressive symptoms). However, since both measures have been found to be reliable in other adult populations (Andresen et al., 1994; Salmon et al., 2003), further research examining the association between television viewing and risk of depression amongst socio-economically disadvantaged is warranted.

Few underlying mechanisms explaining the positive association between sedentary behaviour and risk of depression have been tested. One mechanism suggested to explain the association between sedentary behaviour and risk of depression relates to social withdrawal (Kraut et al., 1998; Lewinsohn, 1974). This hypothesis proposes that the more frequently people watch television or use the computer/internet, the further they remove themselves from social interaction, which in turn increases their risk of depression (Kraut et al., 1998; Lewinsohn, 1974). However, since in modern times, the internet is most often regarded as a social technology used for communication (e.g. via chat rooms and e-mailing), this hypothesis may not be applicable to all sedentary behaviours, as some studies have found greater internet/computer use to be associated with a decreased risk of depression (Kraut et al., 2002; Shaw & Gant, 2002). Those intervention studies were aimed to increase communication and socialisation, and therefore it may be that the purpose and content of sedentary activities, rather than the time spent
undertaking them, has the greatest impact on the risk of depression. For instance, had the interventions involved surfing the internet for non-social activities (e.g. educational or work-related purposes), results may have shown an association with an increased risk of depression. Social support in general is independently linked to a decreased risk of depression (Brummett et al., 2005), and therefore social support associated with increased online communication may have been the underlying mechanism explaining the reduction in depressive symptoms with high computer/internet use observed in those studies. Collectively, these findings suggest that sedentary behaviours may not all have the same effect on risk of depression. The current study did not specifically identify the domain (e.g. leisure-time or work-related) or purpose of each sedentary behaviour, and this should be considered in future research.

**Interactions between sedentary behaviour, physical activity & risk of depression**

The findings of this study indicated no interaction between sedentary behaviour (total sitting time), leisure-time physical activity and risk of depression. In other words, contrary to expectancies, and to the findings of one existing study (Sanchez-Villegas et al., 2008), positive associations between sedentary behaviour and risk of depression were not altered by participants’ leisure-time physical activity levels. In that previous study (Sanchez-Villegas et al., 2008), depression was not reported exclusively as the outcome measure (e.g. the outcome measure [mental disorder] also included stress and anxiety) and a longitudinal design was used, which may account for the differences in results.
Due to the large number of both physical activity and sedentary behaviour variables included in the current study, the potential number of two-way and greater interactions that could have been examined was very large. For simplicity this study only focussed on two key indicators of these behaviours (leisure-time physical activity and total sitting time), but given the limited and contradictory findings of existing research, further investigation of interactions between physical activity, sedentary behaviour and risk of depression is warranted.

4.5.1. Limitations

One major limitation of the current study was its cross-sectional design, which does not allow for causality or the direction of relationships to be determined. For example, it is not known whether sitting time increases the risk of depression, or whether those with depressive symptoms choose to engage in more sedentary behaviour than those without symptoms as a result of their depression. However, little research has investigated the associations between the domain and social context of physical activity and risk of depression, or the associations between sedentary behaviour and risk of depression, and hence the present cross-sectional findings provide important insights in this research area.

A second limitation was that self-report measures were used to assess physical activity, sedentary behaviour and risk of depression. Although all measures were well-validated (Craig et al., 2003; Radloff, 1977), factors such as recall difficulties, error in judgment and socially desirable responses (e.g. women reporting higher than actual levels of physical activity and lower levels of
sedentary behaviour) potentially limit the results. Furthermore, it is not known how the accuracy of reporting physical activity and sedentary behaviours varies according to mood state. Future studies could utilize objective measures such as accelerometers and Activpals for assessing physical activity and sedentary behaviour. Finally, women with missing data on any covariates (e.g. education, income, BMI) were excluded from regression analyses in the present study. Chi-square analyses showed that a significantly greater proportion of women excluded for this reason were at risk of depression when compared to those who were included. Therefore, a disproportionately higher number of women at risk of depression may have been missed in analyses, which may have affected results by reducing the power of those analyses, or the variability in depressive status in the sample.

4.5.2. Strengths

A major strength of this study was the inclusion of a large, population-based sample of women living in socio-economically disadvantaged neighbourhoods. As very few studies have assessed the levels of physical activity participation in socio-economically disadvantaged Australian women, physical activity levels are difficult to compare. The current study found women reported a mean of 3.4 hours leisure-time physical activity per week, whereas results from one other Australian study found that low-income women reported a mean of 2.1 hours leisure-time physical activity per week (Brown et al., 2001b). However, that study included only mothers of young children and therefore lower physical activity levels would be expected, as having children has been found to be a barrier to
physical activity (Brown et al., 2001b; Brownson et al., 2001). The proportion of women at risk of depression in this study (37%) was somewhat higher than what has been previously reported in socio-economically disadvantaged Australian women (measured by education; 23%) (Brown et al., 2005a). That study, however, included only women aged 45-50 years, which is slightly older than the current study’s sample. Nevertheless, the proportion of women at risk of depression in the current study was similar to what has been previously reported in socio-economically disadvantaged women in the United States (measured by education; 41%) (Bromberger et al., 2004). Although the recruitment of a large sample of women from disadvantaged neighbourhoods was a strength, it should be noted that a proportion of these women were not categorised as socio-economically disadvantaged on the basis of individual level indicators (e.g. 27% had a University degree/higher degree). Nonetheless living in a socio-economically disadvantaged neighbourhood is itself a risk factor for physical inactivity (Kavanagh et al., 2005; van Lenthe, Brug, & Mackenbach, 2005) and depression (Ross, 2000), independent of individual level indicators.

The sample in the current study provided good power to detect associations, even after controlling for several important covariates including age, BMI, marital status, education, employment status, household income, children living at home, country of birth and physical health. Finally, few studies have examined the associations between domain and social context of physical activity and risk of depression, particularly in women (Teychenne, Ball, & Salmon, 2008b). In addition, very little research has considered the relationship between sedentary
behaviour and risk of depression, and only one previous study has assessed the interaction between sedentary behaviour, physical activity and risk of depression (Sanchez-Villegas et al., 2008). This study therefore adds to an important but limited evidence base, and extends this evidence to socio-economically disadvantaged women who are a population group at a great risk of physical inactivity (Armstrong, Bauman, & Davies, 2000; Bensenor, Rexrode, & Manson, 1999) and depression (Scarinci et al., 2002; Weissman & Olfson, 1995).

4.5.3. Future research/implications

The findings from this study provide support for an inverse association between physical activity and risk of depression in women living in socio-economically disadvantaged neighbourhoods. Specifically, it found that undertaking physical activity during leisure-time and physical activity for transport was associated with a lower risk of depression. Further, some involvement in leisure-time physical activity with one or more others was associated with a reduced likelihood of depression. Finally, generally spending greater amounts of time in sedentary behaviours was associated with a greater risk of depression.

Since depression is a major cause of physical and psychosocial illness (Paluska & Schwenk, 2000) as well as being Australia’s most incapacitating illness (Ustun & Chetterji, 2001), strategies to prevent and manage depression are increasingly important. The findings of the current study suggest that promoting physical activity, in particular for leisure and transport, could be an important aspect in preventing depression. Furthermore, mental health guidelines may be developed
to include some aspect of social/accompanied leisure-time physical activity for additional mental health benefits. Guidelines should also recommend reducing time spent in sedentary behaviours (e.g. sitting time, computer use) in order to further reduce risk of depression.

Since the current study is cross-sectional in design and therefore unable to determine the direction of relationships, further longitudinal studies are needed to confirm this study’s findings. The results of this research also highlight the need for more tightly-controlled intervention studies, involving clinical and non-clinical samples, to provide further evidence of the causal nature of these associations. Further studies should also consider the possibility of an inter-relationship between physical activity, sedentary behaviour and risk of depression. It is important that future research also focuses on understanding the influences on physical activity and sedentary behaviour amongst socio-economically disadvantaged women in order to identify strategies, which will help inform the development of interventions aimed at reducing the risk of depression through the promotion of an active lifestyle in this high-risk group. Thus, the next chapter presents a qualitative study, examining the perceived influences on physical activity and sedentary behaviour amongst women living in socio-economically disadvantaged neighbourhoods and experiencing depressive symptoms.
CHAPTER 5: A qualitative investigation of the perceived influences on physical activity and sedentary behaviour, as well as potential strategies to promote healthy behaviours in socio-economically disadvantaged women experiencing depressive symptoms†

5.1. Introduction

As discussed in previous chapters (see Chapters 2 and 4), research has found that participating in physical activity (Teychenne, Ball, & Salmon, 2008b) and engaging in lower levels of sedentary behaviour (Sanchez-Villegas et al., 2008; Sanchez et al., 2008) are associated with a lower risk of depression. In particular, the previous chapter found that engaging in greater levels of leisure-time and transport-related physical activity and lower levels of computer use, screen-time and sitting were associated with a lower likelihood of depression. Several population groups have been found to be at a greater risk of depression, including women (Wilhelm et al., 2003) and adults of low socio-economic position (Lorant et al., 2003). These population groups are also at increased risk of physical inactivity (Gidlow et al., 2006; Sisson & Katzmarzyk, 2008) and therefore are an important target group for research in order to better understand reasons for their increased risk of physical inactivity and how to reduce such risk.

† An abstract of this chapter has been published and is attached in Appendix 30: Teychenne M, Ball K, Salmon J. (2010) ‘Influences on physical activity and sedentary behaviours, and potential strategies to promote healthy behaviours in disadvantaged women with depressive symptoms’ (abstract). Obesity Research and Clinical Practice: 4(S1); S12.
Research examining the correlates of physical activity in women in the general population has increased in recent years, with numerous intra-personal, social and physical environmental factors identified as being associated with physical activity levels. Such influences include time constraints (Ball et al., 2006; Brown et al., 2001b; Juarbe, 1998), family and friend support (Treiber et al., 1991) and access to facilities (Brownson et al., 2001) and transport (Bove & Olson, 2006; Brown et al., 2001b). Furthermore, emerging research has examined the correlates of sedentary behaviour in women. Much like physical activity, the correlates of sedentary behaviour can be described in terms of intra-personal, social, and physical environmental factors, although most studies to date have only described intra-personal correlates of sedentary behaviour such as employment status (Sidney et al., 1996; Sugiyama et al., 2007; Williams et al., 1999) and body weight (Martinez-Gonzalez et al., 1999; Varo et al., 2003).

Observational studies, even longitudinal prospective studies, cannot conclusively establish causal relationships between physical activity or sedentary behaviour and depression. Carefully conducted and controlled intervention studies are therefore required. A number of intervention studies have aimed to reduce the risk of depression through physical activity. Generally these studies have shown that physical activity may reduce depression in women (Anderson et al., 1999; Asbury, Chandrruangphen, & Collins, 2006; Berger & Owen, 1992; Brown et al., 1995; Cramer, Nieman, & Lee, 1991; King, Taylor, & Haskell, 1993). However, one previous study found mood disturbances (including depression) to be a barrier to physical activity (Sallis & Owen, 1999), providing insights of an opposite
causal pathway, and suggesting that the relationship between physical activity and depression may be reciprocal. However, further studies are needed to confirm this hypothesis. Moreover, since no intervention studies have been designed to reduce the risk of depression through reducing sedentary behaviour (e.g. television viewing), the direction of the relationship between sedentary behaviour and depression is still unclear.

Previous intervention studies that were designed to reduce the risk of depression through prescribing physical activity programs amongst women have incorporated strategies to increase physical activity adoption and maintenance. Although studies are few in number, strategies encompassed the intra-personal and social environment and included providing: educational information regarding the mood-enhancing effects of physical activity (intra-personal) (Brown et al., 2001a; Craft et al., 2007), group physical activity programs (social) (King, Taylor, & Haskell, 1993), and additional resources such as exercise videos and manuals (Anderson et al., 1999; Brown et al., 1995).

As identified in Chapter 3, little is known about the correlates of physical activity and sedentary behaviour in socio-economically disadvantaged women, in particular those experiencing depressive symptoms. Further, although results from Chapter 4 identified relationships between components of physical activity and risk of depression as well as relationships between sedentary behaviour and risk of depression, the reason for and direction of those relationships are not known. There is also little known about the most feasible or effective intervention
strategies for promoting physical activity and reducing sedentary behaviour in socio-economically disadvantaged women experiencing depressive symptoms.

This chapter presents the findings of a qualitative study investigating the perceived influences on physical activity and sedentary behaviour amongst women living in socio-economically disadvantaged areas and experiencing depressive symptoms. Since qualitative methods are useful for investigating areas in which little is known, the qualitative design of this study was chosen in order to provide valuable information for the development of strategies to promote physical activity, reduce sedentary behaviour and in turn reduce the risk of depression in this target group.

5.2. Aims and hypotheses

The aim of this study was to gather in-depth information to provide insights into the perceived influences on physical activity and sedentary behaviour in women living in socio-economically disadvantaged neighbourhoods and experiencing depressive symptoms. More specifically, this study aimed to investigate, amongst women living in socio-economically disadvantaged neighbourhoods and experiencing depressive symptoms:

1. The influences on physical activity and sedentary behaviour
2. Women’s perceptions of the direction of relationships between physical activity and risk of depression, as well as sedentary behaviour and risk of depression.
3. Potential strategies that women believe would help them to increase physical activity and reduce sedentary behaviour

Based on the review of the literature (Chapters 2 and 3), it was hypothesised that women living in socio-economically disadvantaged neighbourhoods and experiencing depressive symptoms would identify a range of intra-personal, social and physical environmental influences on physical activity and sedentary behaviour as well as strategies to promote engaging in healthy behaviours (i.e. participating in physical activity, reducing time spent in sedentary behaviours). Furthermore, it was hypothesised that women would perceive both the association between physical activity and depression, and the association between sedentary behaviour and risk of depression as bi-directional/reciprocal. Finally, based on the review of the literature (Chapter 3), it was hypothesised that potential strategies to increase physical activity and reduce sedentary behaviour would encompass the intra-personal and social environment. Few previous intervention studies tested the effects of physical environmental strategies to reduce depression through increasing physical activity. Therefore, the Candidate will propose some novel environmental strategies to do so and test their feasibility in this target group.

5.3. Methods

The present study involved qualitative one-on-one telephone interviews with a sample of women experiencing depressive symptoms selected from a cohort of women participating in the Resilience for Eating and Activity Despite Inequality (READI) Study of 2007/2008 (aged 18-46). The interviews were designed to gain
a deeper understanding of the issues associated with physical activity and sedentary behaviour among socio-economically disadvantaged women experiencing depressive symptoms. The methods and procedures are described below.

5.3.1. Participants

Participants were recruited from the READI cohort, which comprised 4,349 women from 80 Victorian suburbs (40 rural and 40 urban) of low socio-economic position (SEP), based on the Australian Bureau of Statistics SEIFA - Socioeconomic Index for Areas (Australian Bureau of Statistics, 2003) (see sections 4.3.1 for further detail). A total of 284 women were excluded from the sampling pool for the current study because they had reported being pregnant (or did not know whether they were) or had data missing on this variable in the READI study. Furthermore, only women who reported being “at risk” of depression in the READI study (as indicated by a CES-D score of ≥10 [see section 3.4.1 for details]) were included in the eligible sampling pool for the present study (n=1540). Of those respondents, 1,129 indicated that they were willing to be contacted for further research. Since 423 had already been contacted regarding other qualitative research conducted within the READI study (Welch et al., 2009), those women were also excluded from being contacted for this study. From the remaining sample of 706 women, a random sample of 110 were initially contacted, and 26 (24%) responded that they were willing to participate. Of those who agreed, seven (6%) were excluded after screening on the basis that they were no longer currently experiencing depressive symptoms. One eligible woman was
unable to be contacted again after screening. Recruitment continued until data saturation occurred i.e. the point at which no new information or themes were observed (Guest, Bunce, & Johnson, 2006) (n=18).

5.3.2. Ethics
Ethical approval from the Deakin University Human Research Ethics Committee was obtained for the current study: ‘Influences on Women’s Physical Activity Study’ (EC 55-2009).

5.3.3. Recruitment procedures
To recruit socio-economically disadvantaged women experiencing depressive symptoms, eligible women (see section 5.3.1) were initially sent a letter inviting them to take part in a qualitative study examining the influences on women’s physical activity (Appendix 6). Women were given a reply-paid slip to return to indicate their interest in participating (Appendix 7). Following the Dillman protocol (Dillman, 1978), non-respondents received a mailed reminder three weeks later (Appendix 8). Interested participants were called and were screened again using the CES-D 10 to confirm the presence of depressive symptoms and eligibility (Appendix 9). Eligible women arranged a time with the Candidate for the one-on-one telephone interview and were sent a plain language statement as well as a consent form (Appendix 10), which they were required to sign and send back before participating in the interview.
5.3.4. Interview procedures

The interview schedule was piloted and refined with five participants (Appendix 11), including women who were experiencing depressive symptoms and living in socio-economically disadvantaged areas. Semi-structured one-on-one interviews with participants were conducted by the Candidate over the telephone during June-August 2009. Each interview ran for approximately 20-30 minutes. With permission from the participants, interviews were recorded. Key points were noted throughout the interviews by the Candidate. After completing the interview, participants were sent a thank you letter as well as a $20 gift voucher as compensation for their time (Appendix 12). A general results letter was sent to participants two months later (Appendix 13).

5.3.5. Measures

The semi-structured interview schedule (see Appendix 11) was developed based on the social ecological framework, which is useful for guiding research into the intra-personal, social and environmental correlates of physical activity and sedentary behaviour (Sallis & Owen, 1999). A list of open ended-questions was included in the interview, assessing the potential intra-personal, social and physical environmental influences on physical activity and sedentary behaviour. Prompts were used as examples for some questions if women could not provide an answer. Women were asked to discuss how physical activity and sedentary behaviours (e.g. television viewing, sitting at the computer) behaviours made them feel mentally and physically. Television viewing and computer use were provided as examples in the interviews since most research on the association
between sedentary behaviour and depression has included them as variables (see Chapter 2). Women were also encouraged to suggest strategies that they thought may assist them in being more physically active and reducing sedentary behaviour (described in more detail below).

**Depressive symptoms**

When screening for depressive symptoms, the 10-item version of the Centre for Epidemiologic Studies Depression Scale (CES-D) was utilised (Appendix 9). The CES-D is a well-validated measure of depression (Andersen et al., 1994; Radloff, 1977) and has been used in previous studies examining the association between physical activity and depression (Galper et al., 2006; Stephens, 1988). It includes questions that relate to various symptoms of depression that may have been experienced in the past week, which indicate whether a woman is at risk of depression. Respondents rated themselves on a 4-point severity scale. Examples include: “I was bothered by things that usually don’t bother me” [Rarely or none of the time (0); Some or little of the time (1); Occasionally or a moderate amount of the time (2); Most or all of the time (3)]; “I was happy” [Rarely or none of the time (3); Some or little of the time (2); Occasionally or a moderate amount of the time (1); Most or all of the time (0)]. CES-D scores of 10 or greater indicated that the participant was at risk of depression and therefore eligible to participate in the present study (Andersen et al., 1994).
Participation in physical activity

As presented in Chapter 4, leisure-time physical activity was most consistently related to women’s depressive symptoms than other domains of physical activity (i.e. domestic, work-, and transport-related). Further, individuals tend to have more volitional control over leisure-time physical activity (as opposed to other domains). Moreover, leisure-time provides potentially greater opportunities to intervene. Therefore, the interview focussed predominately on leisure-time physical activity, but where relevant, participants were also encouraged to discuss other domains of physical activity. Factors influencing leisure-time physical activity that are particularly relevant to individuals experiencing socio-economic disadvantage may include time constraints (Brown et al., 2001b), stress (Baum, Garofalo, & Yali, 1999), lack of money (Brown et al., 2001b) and lack of transport (Brown et al., 2001b). Thus the present study focussed particularly on exploring such factors. Women were asked how often they were physically active for leisure as well as how it made them feel physically and mentally. In exploring the direction of the association between physical activity and risk of depression, women were also asked, “If you’re feeling down, how does that impact on your leisure-time physical activity?” and “What’s the one thing that would most help you be more active when you’re feeling down?”

Intra-personal influences on physical activity

Intra-personal influences on physical activity, such as past exercise experience, feeling tired, lack of time, stress and poor physical health, were assessed by asking open-ended questions such as “If you’re feeling tired, how would this
impact on your leisure-time physical activity?” and “How feasible do you think it would be for you to be active even when you’re feeling tired or stressed? Why/why not?” (see Appendix 11).

**Social influences on physical activity**

Social influences on physical activity, such as having a friend to be active with, children, and being encouraged/discouraged by others to be physically active, were assessed by asking questions such as “In what ways does your friends/family physical activity influence your physical activity?”, “How feasible do you think it would be for you to be active with a friend? Why/why not?”, “Do you enjoy social physical activities more or individual activities?” and “Does having children impact on your leisure-time physical activity? If so, how?”

**Physical environmental influences on physical activity**

Physical-environmental influences on physical activity, such as access to facilities, safety, cost, transport and weather, were assessed by asking questions such as “Are there any recreational facilities near where you are? What are these like?” [Prompts used: Affordable, clean] and “What do you think would help you be more physically active around your neighbourhood?” [Prompts used: Better facilities, well-lit streets/walking paths, cycle track, transport, childcare?]

**Participation in sedentary behaviour**

Participants were asked how much time they spent in sedentary behaviours such as television viewing, computer use and time spent driving in a car, as well as
how doing those activities made them feel physically and mentally. A particular
focus was on leisure-time sedentary behaviours. In exploring the direction of the
relationship between sedentary behaviour and risk of depression, women were
asked “How does watching television/sitting at the computer make you feel
physically and mentally?”, and in exploring the potential reverse causal
association “If you’re feeling down, how does that impact on the time you spend
sitting watching television/sitting at the computer?”

**Intra-personal influences on sedentary behaviour**

Potential intra-personal influences on sedentary behaviour, such as enjoyment of
those behaviours and stress, were assessed through questions including “What are
the main reasons you watch television?” and “If you’re feeling stressed, how does
that impact on how much television you watch?” Women were also asked
questions regarding the feasibility of overcoming several potential intra-personal
barriers to reducing sedentary behaviours such as “How feasible do you think it
would be for you to turn the television off even when you’re feeling tired?
Why/why not?”

**Social influences on sedentary behaviour**

Potential social influences on sedentary behaviour, such as being
discouraged/encouraged to watch television or sit at the computer, and having
children were assessed by questions such as “How would you say your
friends/family influence you to watch television? Use the computer?”, “How does
having children impact on the time you spend sitting?”, and “How feasible do you
think it would be for you to not watch television at night, even when your family are watching it? Why/why not?”

**Physical environmental influences on sedentary behaviour**

Potential physical environmental influences on sedentary behaviour, such as the number of televisions in the home and the weather were assessed by questions such as “If the weather is nice, would that impact on the amount of time you spend watching television/sitting at the computer? How?”

**Strategies to increase physical activity and reduce sedentary behaviour**

In order to generate suggestions for potential strategies to increase physical activity and reduce sedentary behaviour, women were asked questions such as “What is the one thing that would most help you be more active when you’re feeling down?”, “What is the one thing that would most help you to not sit and watch television /use the computer when you’re feeling down?” and “Do you have any other ideas on how we can help women to be active and reduce the time they spend sitting?” The feasibility of modifying the way in which one engages in television viewing (e.g. standing up), was assessed through questions such as “How would standing up whilst watching television impact on the time you spend watching TV?” and “How feasible would this be?”

**Demographic characteristics**

As most demographic information was collected previously in the READI survey, women were asked only two questions regarding their demographic
characteristics: Age (years) and occupational status (working full-time; working part-time; student; unemployed; home duties/raising children full-time).

5.3.6. Data analysis

Each interview was digitally recorded and then later transcribed. Following each interview, key points about emerging and expected themes were written down by the researcher in order to direct the next interview, which is consistent with the principle outlined in ‘grounded theory’ of qualitative research (Corbin & Strauss, 1990). Pseudonyms were assigned to each transcript, ensuring participant confidentiality. After reviewing all transcripts, the qualitative data analysis program NVivo was used to organise data and perform thematic analyses following the methods described by Green et al. (2007). The first step in data analysis, immersion of the data, consisted of repeated reading of interview transcripts. Following this step, data were coded as descriptive labels (e.g. ‘having children reduces television viewing time’) and concurrently categorised by linking coded data together (e.g. ‘intra-personal influences on television viewing’) (Green et al., 2007). In order to check the validity of the interpretation of the data, researcher triangulation was employed. A random subset of three transcripts was cross-coded by a second researcher (PhD supervisor) to check for inter-coder agreement. No discrepancies in coding or interpretation were observed. Finally, key themes and concepts (e.g. ‘The impact of children’) were then linked to direct quotes, allowing for a thorough interpretation of results. Illustrative quotes are provided in the results (Section 5.4) with the age and assigned pseudonym of participants.
5.4. Results

Demographically, women ranged from 29 to 51 years of age. Two-thirds of women had children living at home (67%), with just over half the sample in a married or defacto relationship (56%). Over two-thirds of women were employed part-time or full-time with just under one-third of women participating in home duties (i.e. raising children, domestic work in the home) full-time. One-third (33%) reported a low level of education (had not completed secondary education), 39% a medium level (completed year 12 and/or vocational training), and 28% had a university degree. In comparison, of those who refused to participate, about one-half of those women had children living at home (52%), with just over one-half of women being in a married or defacto relationship (52%). Two-thirds of women were employed part-time or full-time and about 20% of women participated in home duties. Just under 18% of women reported a low level of education, 58% reported a medium level of education, and 24% had a university degree. Chi-square analyses showed that there were no significant differences in demographic characteristics between those who participated and those who refused to participate.

5.4.1. Themes arising

The qualitative data revealed several expected and emergent (unanticipated) key themes. Expected themes related to physical activity included: depression; time constraints; the impact of children; tiredness; social support; and environmental influences on activity (particularly cost, safety and accessibility). Emergent themes related to physical activity correlates included the atmospheres of sports
clubs. Expected themes related to sedentary behaviour included: depression; and the influence of childhood television habits. Emergent themes related to sedentary behaviour correlates included the impact of children. These key themes are presented within the intra-personal, social and physical environmental sections of the social ecological framework (Sallis & Owen, 1999) (see Table 5.1). Potential strategies which were suggested by women to increase physical activity and reduce sedentary behaviour are summarised in Table 5.2. These are presented in detail in each relevant section (i.e. physical activity and sedentary behaviour sections).
Table 5.1 Perceived influences on physical activity and sedentary behaviour

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<th>Physical activity influences</th>
<th>Sedentary behaviour influences</th>
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<td><strong>Intra-personal</strong></td>
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Table 5.2 Potential strategies to increase physical activity and reduce sedentary behaviour

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5.4.2. Physical Activity

The majority of women described undertaking physical activity for leisure on most (4-7) days, with only a few women not undertaking any form of leisure-time physical activity. Most women described their reasons for participating in physical activity as satisfying a need for a ‘time-out’ and to feel better mentally.

“just to get some fresh air and exercise myself and clear the head”
(Kim, 46)

“for me, the main thing is the mental, just headspace that you can get just by walking out of the house by yourself for a while” (Carrie, 41)

Intra-personal influences on physical activity

Theme 1: The relationship between physical activity and depression

It was clear that the majority of women found being physically active a great challenge when suffering depressive episodes. The negative impact depression had on physical activity was evident not only for leisure-time physical activity, but also in other domains of physical activity such as household physical activity.

“Generally when I’m feeling depressed, I end up shutting down which I know is not a good thing, but that’s what I do and I lock myself away and it’s a real struggle then for me to push myself to go for a walk which sometimes I can do, it depends on sort of what state I’m in with the depression as to what I’m able to do” (Wendy, 45)

“you just struggle from day to day, like getting your normal things done, so I wouldn’t even push myself in my housework or anything like that, I would just do what I have to do because it’s so much harder to achieve things” (Anne, 35)
Despite the struggle women faced in attempting to be physically active when feeling down/depressed, most women recognised the importance of physical activity in lifting their mood and managing their depressive symptoms, highlighting the existence of an alternative causal pathway in the relationship between physical activity and depression.

“Yeah, it [physical activity] makes me feel good, you know, I feel like I’m actually achieving something rather than just sitting at home and doing nothing” (Lisa, 29)

“I think walking is really, really important when you’re suffering with depression, I think it’s a great one to get out there and make yourself do it regardless” (Wendy, 45)

“I find that I cope better. And I do sleep a lot through the days, when I walk I don’t need that sleep” (Anne, 35)

Although several women understood the benefits to their own mental health of undertaking physical activity, some were unable to overcome the barrier their depression presented.

“Well I do [physical activity] because I know that that’s what you’re supposed to do and I know when I do I feel better, if I’m doing it, but I know that it’s very, very difficult once I’m in that frame of mind to actually get out of the house and do something” (Carrie, 41)

“I probably wouldn’t go...Yes and I know... I know myself if I did go I would feel better but sometimes you just can’t drag yourself to do it” (Rebecca, 46)

In contrast to most, one woman was able to use her depressive mood as a motivation to be physically active by concentrating on the benefits that the activity would provide to her mental health.
“I try and focus on how I feel when I actually get back. And I know that exercise is always good for if you’re feeling down. So, yeah I do try and focus on how I’ll feel after it” (Melissa, 43)

**Theme 2: Time constraints**

Time constraints were by far the most common perceived barrier to physical activity, mentioned by nearly every woman. Most women described prioritising their work and family responsibilities over their own physical activity.

“it’s the scheduling in between what everyone else in the household does, there’s not much schedule time left” (Danielle, 40)

“I leave very early in the morning, and then get home... and then I’ve got children and it sort of just becomes more problematic to kind of fit it in on some days” (Kim, 46)

Conversely, one woman admitted that she always had enough time for physical activity in her day and had worked out the most appropriate time to fit physical activity into her daily routine. However, she was still unable to prioritise physical activity into her life.

“Oh look, there’s always time, I always think if I got up early in the morning I could do it, but I don’t because I’m usually tired because I’ve been to bed late the night before, so it’s fitting it in to a time where you can be by yourself and early morning’s really the only time that my husband’s here that I could go for a walk by myself without the kids” (Carrie, 41)

**Theme 3: Tiredness**

Long working hours and family responsibilities such as looking after children were perceived to negatively impact on many women’s energy levels. Although several women described how physical activity increased their energy levels,
most women attributed their lack of physical activity at least partly to feeling tired/lacking energy.

“It’s because I’m tired by the time I get home from work and do the things I’ve got to do. I’m just too exhausted to go for a walk” (Wendy, 45)

“you know from experience when you get out and do it you feel better, but it’s so hard to actually get off the couch and go and do it when you’re feeling tired and it’s the end of a long day and the kids are finally in bed or something and you think nah, I just can’t be bothered” (Carrie, 41)

However, a few women believed that they were able to overcome the barrier of feeling tired and would undertake physical activity by focusing on the benefits of physical activity and how they would feel afterwards.

“I’m determined to lose just that little bit of weight so… I always try and focus on how I’ll feel after I’ve come back from a walk…Rather than focusing on feeling guilty because I didn’t go for a walk, I just sat on the couch. So, I try and look at the positive aspects of it” (Melissa, 43)

“I sometimes actually find that I feel better, especially if I’m feeling tired, if I go for a walk. So it sort of freshens you up” (Kim, 46)

Social influences on physical activity

Theme 4: The impact of children

Nearly all mothers described putting their children’s needs before their own, finding it difficult to participate in regular physical activity.

“When I’m with them now I’ve got to think of them first, so I’m always putting what I want to do second” (Jemma, 34)

“I guess on the negative side is that sometimes doing things for them [children] means that I don’t have as much time to do things myself…” (Kim, 46)
Many mothers of young children felt their own physical activity was limited by their responsibilities as a parent as well as their children’s physical capabilities. 

‘you can’t take them with you ‘cause they can’t keep up, you know? 
(Catherine, 33)

“I used to do a lot more, I had my third child... and I’m finding that more difficult now, I mean we can go out with him for a little stroll on his bike or something like that, but that doesn’t give me the level of exercise that I feel like I want to, I can’t walk as fast as I want to...” (Carrie, 41)

However, the same woman indicated that she was able to overcome this barrier when her child was younger and able to be pushed in a pram.

“When it was me and the pram, it was easy because I could just push him and go for as long a walk as I wanted to, whereas I’m just finding the age that he’s at now, it’s quite difficult, he can’t walk far enough for me to walk...” (Carrie, 41)

**Theme 5: Social support**

Social support was mentioned by the majority of women as a factor that facilitated physical activity by either increasing their enjoyment of physical activity, increasing their motivation to be active, and/or providing opportunities to be active.

**Social support to increase enjoyment:** Women mentioned enjoying social physical activities more than individual physical activities as they could use the activity as a time to catch up with friends and family.

“I guess just being able to catch up with my sister, and during the week you might not get as much chance to walk through the day, so being able to catch up [with] her, see what’s going on, and that kind of stuff, rather
Despite enjoying social physical activities, a few women mentioned that the logistics of organising an exercise session with someone that prevented them from undertaking social physical activities.

“it’s just hard to organise someone else with your own time. It’s actually easier for me to go by myself or wait till my husband comes home” (Bec, 46)

“it’s just timing really that is probably the most challenging thing, what everyone’s up to. But then that’s why I probably tend to do it more on my own when you’ve got a spare half hour just go and do something you know rather than trying to coordinate it with a friend who might also have children” (Liz, 43)

Social support to increase motivation: It was clear that for most women, social/accompanied physical activity was a major motivational factor, whether it be providing motivation to start exercising, or motivation to push themselves harder during exercise.

“if you’re walking with a friend, I can walk for an hour and not even think about it, whereas if you go yourself, it’s hard to push yourself to do that bit extra” (Carrie, 41)

“When I’m by myself it’s almost like ah well if I decide to give up then I can give up and I just stop at my own leisure. But when I’m doing it in a group or team situation you can’t really stop cos you’ve got that added thing about not letting the team down or not looking like a failure in front of everybody else” (Amy, 30)

Social support to increase opportunities: Many women mentioned that lacking social support from friends, family and partners was a key barrier to their physical activity. Reasons for this lack of social support included partner’s long working
hours as well as women’s perceptions that others’ expectations (e.g. regarding housework and dinner) come before a woman’s exercise/health.

“there’s a community gym that’s open and I said to my husband, you know, if you could get home by 6 o’clock, it’s only open ‘til 7, but I could do, I could go to the gym for an hour, but of course he doesn’t get home ‘til late” (Carrie, 41)

“my husband works as well...so I’ve got to get the meal on and he’s not an Aussie type man, he’s a European man, you know wants dinner on the table when he comes home from work. So kind of like you know ‘where’s my food come on what is this? ’ ‘Yes it’s coming man it’s coming’” (Grace, 43)

Conversely, a few women described having excellent social support from their partners to be physically active. This was achieved through their partners offering to mind the children, providing those women with an opportunity to undertake leisure-time physical activity.

“he looks after the kids in the morning if I want to go for a walk” (Jemma, 34)

“My husband is very good at looking after the kids when he is around on weekends and stuff so I can go and do something” (Liz, 43)

Environmental influences on physical activity

Theme 6: Cost

Most women mentioned the cost of activities as a barrier to being physically active.

“if you’ve got the money go for it, but if you haven’t got the money and you haven’t got the time to do it well you can’t do it then” (Grace, 43)
Although money/cost was a factor which many women said prevented them undertaking physical activity, for one woman who could afford the outlay, the cost of her gym membership was a motivating factor.

“I guess it’s the fact that I’ve just joined the gym and I’ve paid for it, so that’s enough motivation for me to keep going.” (Pia, 31)

Another woman saw cost-free options as preferable.

“...walking or exercise biking or doing something that didn’t cost something...would probably be my first option and then perhaps look at something after that.” (Kim, 46)

Theme 7: Safety

The issue of neighbourhood safety arose as a barrier to physical activity for several women. Although about half of women in this study felt their neighbourhood was safe, it was clear that for the other women, the lack of safety or poor reputation of the area in which they lived were major influences on their physical activity.

“Unfortunately one of the parks close to me a couple of people have chosen to commit suicide in there, so... I wouldn’t go walking at night and I wouldn’t go walking first thing in the morning” (Danielle, 40)

“Being a single mum with four children... I’m too scared. Too many accidents happen so I feel safer in the car” (Sharon, 36)

However, one woman mentioned that as her neighbourhood was not considered ‘safe’ to walk around, a strategy she would use to be more physically active would be to undertake physical activity with someone she knew.
“I wouldn’t be doing [physical activity] by myself because there’s been a lot of attacks around in our neighbourhood... so I’d rather do it with somebody, with my daughter or son or my sister-in-law or... someone that you know... I wouldn’t be doing it by myself, no it’s not safe” (Grace, 43)

**Theme 8: Accessibility**

Access to a variety of facilities and activities was mentioned by several women as an influence on their physical activity, with women suggesting that increasing the number of good facilities in the neighbourhood, particularly those that specifically appealed to women, may be an important strategy to increase physical activity.

“I’d like more access to things like yoga and things like that, not high impact stuff. So maybe just make that more accessible. Classes like that sort of thing.” (Sandra, 41)

“I feel like in this rural environment, it’s quite hard to do things, like often I think I’d like to do something like Pilates or aerobics or something like that, but there’s no organised exercise things like that” (Carrie, 41)

The majority of women described prohibitive distance from home to the nearest facilities, emphasising the need for facilities that are close by.

“I’m about 20 minutes from a large regional town that has facilities such as a swimming pool which I love to swim but it’s just not feasible to do... well it’s actually about half an hour. So by the time it’s an hour a round trip, so yeah it’s not feasible at all” (Melissa, 43)

However, one woman mentioned how travelling extensive distances to facilities was an option because she already travelled a long way to use the closest swimming pool.

“There’s no indoor pool here. I’ve just driven this morning to [Town] which is 50 minutes away with my four-year-old for swimming lessons and
While she has her lesson I swim myself and just do laps but that’s the closest indoor pool” (Liz, 43)

Similarly, one woman described how travelling 20 minutes to reach facilities was possible due to her being accustomed to travelling such distances regularly.

“I’m used to catching public transport and walking and I usually take around that amount of time to get from any, from A to B, so for me 20 minutes is not much” (Pia, 31)

**Theme 9: Atmospheres of sports clubs**

One distinct theme that emerged was the perception of negative atmospheres of sporting clubs that several described as deterring them from being physically active. Aspects of sporting clubs that contributed to these perceptions included the social drinking that can be involved, as well as the fact that many gyms were viewed as male-oriented.

“We have a gym but…I’ve been a couple of times but I don’t really like the atmosphere...It’s full of blokes...Yeah, yeah, blokes and sweating...” (Rebecca, 46)

“I don’t want to go and join netball like most of the other women in town and I’m not into basketball, and you know, there are all of those social things come with other things as well. Like, you know, the netball is part of the football which is a huge drinking thing, and you know... I’m not pushy like those other netball women” (Danielle, 40)

One woman described how having a friendly atmosphere at a gym/fitness facility was a major influence on her physical activity.

“…the atmosphere’s another [factor]... when you walk into the gym... they’re nice to you and... they basically make you feel comfortable. I’m the type of person that if they don’t make me feel comfortable, I’m going to shy away and say no, I don’t want to go” (Edith, 51)
5.4.3. Potential strategies to increase physical activity

When asked what may help them become more physically active, women provided a range of intervention strategy ideas. The most frequently suggested strategies included: family and friend support; childcare; women’s only classes; education/public awareness campaigns; provision of information on physical activity options in the neighbourhood; and greater access to exercise facilities.

**Strategy 1: Friend and family support for physical activity**

Engaging more family and friend support for physical activity was by far the most frequently suggested intervention strategy to increase physical activity amongst women in this study. The majority of women suggested that when feeling down/depressed, the one thing that would help them be more physically active would be having someone else motivate them or exercise with them.

“I think someone would ... really push me, someone...who motivates me, says, “Come on, come for a walk”” (Sonja, 34)

“having someone else to get out there and do something with” (Lisa, 29)

“probably personal contact with someone, to ring up or drop [in] on and go come on, let’s go and do something else” (Carrie, 41)

**Strategy 2: Childcare**

Most mothers of young children suggested that having affordable and short-term childcare in their local neighbourhood would help increase their participation in physical activity.
“definitely temporary childcare is an issue in our area. We’ve really only got one childcare centre and that’s sort of like well you know you book them in for the whole day or not at all. So there’s no sort of just an hour or two type thing” (Liz, 43)

Similarly, one mother mentioned that having social support from family and friends to look after her children would help her become more physically active. This was seen to be a more affordable and convenient option than childcare.

“having someone to look after the kids. You know I guess just for it logistically to be easier. When you’re feeling down you can’t deal with all the organisational side of things as well so you just don’t do it.” (Liz, 43)

**Strategy 3: Education/Public awareness campaign**

Another frequently mentioned strategy for increasing physical activity was a public awareness campaign to educate women on the mental and physical health benefits of physical activity. Further, a number of women believed education sessions could be used to help women attain a positive frame of mind and learn how to overcome common barriers to physical activity. On further questioning, it appeared that those women who suggested a public awareness campaign themselves had a reasonable knowledge of the benefits of physical activity. However, they attributed other women’s lack of physical activity to a lack of knowledge of the benefits associated with physical activity.

“I would maybe do perhaps a marketing campaign. And I’m thinking perhaps market it to women’s groups corporate, or professional groups... Or through the local gyms... an awareness campaign of how much more that they can get out of themselves if they’re physically active” (Melissa, 43)

“I guess it’s about education and women being able to appreciate the benefits” (Kim, 46)
**Strategy 4: Provision of information on available facilities**

Similarly, a handful of women suggested the provision of information regarding locally available exercise facilities and classes would help increase their physical activity. This was described as being useful in helping increase women’s knowledge and awareness of what is available to them in their immediate neighbourhood.

“more information on community notice boards and leaflets in the mail...Just the fact that there are these recreational facilities in the neighbourhood. I’m sure there are more that I’m not aware of, there’s not that much advertising” (Pia, 31)

“Probably more public awareness...about what’s out there...what’s available” (Wendy, 45)

**Strategy 5: Women’s only gyms/classes**

Alongside childcare, education and information on available facilities, an equally as popular suggestion was the provision of women’s only gyms/classes. Women suggested that having women’s only facilities would positively increase their use of gyms/clubs as several women perceived gyms as male-oriented which discouraged them from going.

“a women’s-only gym would be fantastic” (Rebecca, 46)

“if I was to go to a gym I’d probably go to just a female gym rather than [with males]” (Lisa, 29)

**Strategy 6: Greater access to facilities/longer opening hours**

Given that accessibility was overwhelmingly described as a major influence on women’s physical activity by the women in the current study, not surprisingly
having greater access to exercise facilities and classes such as Yoga and Pilates was mentioned by several women as a strategy to increase physical activity (see Section 4.4.1). Furthermore, three women highlighted the need for longer opening hours of existing facilities and activities in order to be able to schedule their physical activity around work and other commitments.

“There is a walking club...And that’s quite often during the day which now doesn’t suit me” (Wendy, 45)

“we have a community gym, but it’s only open limited hours...it’s not like a regular gym that’s open very early and very late... So it is a great facility, but yeah it’s just accessing it at the right time for me. And I think oh, if it was open [at] 7 o’clock in the morning then I could go up there before [my husband] goes to work and before the kids are at school” (Carrie, 41)

Additional strategies to increase physical activity

While the following strategies were only suggested once or twice, these ideas were strongly endorsed by the women who suggested them and in light of the earlier findings on the influences on women’s physical activity they provide further important information on the potential strategies that may be used to increase physical activity amongst disadvantaged women with depressive symptoms. These less frequently mentioned strategies included: mother’s physical activity groups; cost-free activities; social recreation and support groups; and strategies aimed at time management/prioritising physical activity.
**Strategy 7: Mothers’ physical activity groups**

One mother suggested that having physical activity groups for mothers with babies would help her become more physically active. She indicated that it is the lack of day care facilities and cost that would make this a good option.

“more mothers groups that are... orientated towards babies and mothers. So that sort of physical activity where the kids are involved with that activity. Because you just can’t find the day care to leave them and go and do that or the day care is too expensive to do that” (Jemma, 34)

**Strategy 8: Cost-free activities**

When asked ‘what is the one thing that would help you be more active if you were feeling down?’ one woman mentioned having a variety of free physical activities in the neighbourhood.

“[I’d be physically active] if there was a lot of things out there that were for free” (Sharon, 36)

**Strategy 9: Social recreation and support groups**

A couple of women mentioned the need for social networking and recreation groups in order to motivate them to be more physically active. This suggestion may be related to women’s views that being active in a social context would help them commit to attending, or it may have been based on their own preference for undertaking physical activity in a social context.

“maybe a walking group or something like that. That would be good” (Rebecca, 46)

“more social networking clubs” (Edith, 51)
In spite of the logistical barriers mentioned by women, most women agreed that with some planning and effort, it could be feasible to be physically active with someone else.

“if we made a time in advance we could do that” (Jemma, 34)

One other woman suggested that a useful physical activity promotion approach could involve an online support group aimed at identifying why women are feeling depressed as well as helping them overcome that barrier to being physically active.

“Perhaps a support group. It could be an online thing...If people are feeling depression or symptoms of depression, having the strength to be able to pick up the phone and talk to somebody...that’s...maybe the hardest thing is that first step” (Melissa, 43)

She recognised that by providing an online support group, as opposed to a telephone support group, more women would be potentially reached as it may be easier, more convenient, and less confronting for women experiencing depressive symptoms to visit a website, rather than telephone someone.

**Strategy 10: Time management/prioritising physical activity**

Although most women did not directly suggest time management as a key strategy to increase physical activity, the concept of ‘multi-tasking’ emerged as a time management strategy which some women used to fit in physical activity as well as to reduce sedentary behaviour (discussed later). One woman mentioned participating in her own leisure-time physical activity at the same time as she managed family responsibilities in order to fit exercise into her day.
“my four year old [does] swimming lessons and while she has her lesson I swim myself and just do laps” (Liz, 43)

When asked about ideas to increase women’s physical activity, one woman suggested that managing time and prioritising health were the key.

“[It’s] about making time for themselves because often women put family and everyone else before themselves. So it’s about trying to get that priority where their physical exercise and wellbeing is... sort of accepted by them to be a really important thing and that might be a key factor in making sure that their family has wellbeing as well” (Kim, 46)

5.4.4. Sedentary Behaviour

The majority of women described spending about two hours a day watching television. Reasons for television viewing varied, with some women watching it for relaxation purposes and others watching it out of boredom.

“Watching TV, I tend to use it as a relief so when I’ve had enough of the office... I just lose myself in whatever TV programme I’m watching. So I guess it’s relaxing” (Melissa, 43)

“[I watch TV] probably cos it’s night time and you can’t really do anything else” (Sandra, 41)

Intra-personal influences on sedentary behaviour

Theme 1: The relationship between sedentary behaviour and depression

A distinct theme that emerged from the interviews was the way women used television as a tool to ease depressive symptoms by distracting their negative thoughts. The concept of “switching on to switch off” was mentioned by several women as they described how watching television allowed them to remove themselves from their depressive frame of mind.
“It just makes me forget about what I’m dealing with sometimes. But obviously the stressors are still there as soon as you stop watching and start thinking again” (Amy, 30)

“…having the TV on distracts you from feeling low” (Danielle, 40)

In contrast, one woman described the act of sitting in front of the television as almost a diversion, using it as a place where she could pass time, particularly when feeling depressed.

“Look, if you’re feeling down, you just have the telly on and you’re not really even watching it half the time, you’re just sitting in front of it for the physical act of, you know, sitting there pretending you’re doing something I think” (Carrie, 41)

There was no indication from any women who were interviewed that they perceived television viewing increased their symptoms of depression.

**Theme 2: The influence of childhood television habits**

An emerging theme was the strong influence that childhood television habits had on habits in adulthood. Women mentioned that having their television viewing restricted by their parents as a child influenced them in adulthood to watch less television.

“I didn’t get to watch TV much as a kid. Probably an hour I think, after school and that was about it. So, maybe that’s why I don’t like the TV on all the time”(Catherine, 33)

“housework had to be done first...and the chores had to be done first and then you could sit down and watch whatever you wanted to watch...That’s what’s happening with me now... because of that rule I’d rather do all my housework, get everything done, prepare dinner, do what I need to do and then when I know that I’ve got nothing else to do then I can sit down and watch TV. So it’s the same thing when I was a kid, the same thing now” (Grace, 43)
Conversely, some women mentioned that having their television viewing restricted as a child had the opposite effect on their adult television habits.

“We weren’t allowed to watch a lot of TV. So when we became adults and we had our own TVs when we moved out of home, all I wanted to do was watch TV” (Jemma, 34)

In contrast, one woman mentioned that she spent large amounts of time as a child watching television due to her parent’s excessive television viewing behaviours. Therefore, as an adult she tried to restrict her television viewing.

“my mum will turn on the television as soon as she comes home and it’s on in the background all the time, and I guess I’ve made a conscious effort not to ever do that because I used to hate that. So I try not to have it on unless I’m actually sitting watching it” (Carrie, 41)

Social influences on sedentary behaviour

Theme 3: The impact of children

Of those mothers who watched relatively less television, most attributed this to having young children. Reasons for this included having a lack of time to sit and watch television as well as wanting to demonstrate positive role modelling for their children.

“[Having kids makes a] big impact cos you never get to sit. It’s always ‘mum get me something’” (Sandra, 41)

“before you had the kids you’d sit and watch the telly more whereas now that’s just... something that you do for an hour a day. You could waste a whole afternoon sitting watching telly, whereas you don’t have time for that... you’re doing your housework or you’re doing something with the kids” (Anne, 35)
Environmental influences on sedentary behaviour

Theme 4: Weather

The only environmental factor mentioned by women as an influence on their sedentary behaviour (in particular television viewing) was the weather. Most women suggested experiencing a sense of guilt for watching television on a warm or sunny day.

“if it’s sunny, I’ll definitely want to be outside. Watching TV would probably be the last thing I’d want to do” (Pia, 31)

“as soon as the sun is out...you think ‘okay, well I shouldn’t be [watching TV]’... you feel guiltier sitting inside watching television” (Carrie, 41)

However, there seemed to be no sense of guilt associated with watching television on days when it was raining or cold, with one woman describing her enjoyment of sitting and watching television when it is raining.

“you're sitting in front of your lounge room, watching TV while it's pouring outside, and it’s fantastic” (Edith, 51)

Although most women agreed that it would still be feasible for them to turn the television off even when it was raining outside, one woman suggested that the weather would make no difference to the amount of television she watched.

“I don’t turn the TV off. I leave the TV on [when] the weather is bad outside, and when it's good” (Sonja, 34)

5.4.5. Potential strategies to reduce sedentary behaviour

Most women interpreted the term ‘sedentary behaviour’ as a lack of physical activity. Therefore, when asked about strategies to reduce time spent, for
example, sitting and watching television, most women reiterated their suggestions for increasing physical activity (e.g. going for a walk with a friend). Only two additional (non-physical activity) strategies were mentioned by women that could be used to reduce sedentary behaviour. These strategies included multi-tasking, and standing rather than sitting to watch television or use the computer.

**Strategy 1: Time management and multi-tasking**

Although women did not explicitly suggest ‘multi-tasking’ as a strategy to reduce sedentary behaviour, discussions showed that many women already did this and felt it was a good strategy to reduce sedentary behaviour (e.g. sitting to watch television). For example, women described how they reduced time spent sitting by simultaneously completing household chores (standing up) whilst watching television.

“I use the commercial breaks to run out and do stuff” (Melissa, 43)

“When I watch telly, I often iron as well” (Carrie, 41)

“Well, I try and do the washing...I try and give myself an activity to make myself feel better about spending so much time watching television during the day. So I do try and stand up, but it is much more comfortable to lie down while you’re eating biscuits” (Danielle, 40)

**Strategy 2: Standing versus sitting**

When women were asked if they would consider standing as opposed to sitting for activities such as television viewing and computer use, there was a mixed response, with some women perceiving it as a feasible option and others adamant that it was not feasible.
“I actually do stand a lot when I’m watching TV, only because of the fact that my back’s not very good...I’ve been given advice by my GP to do it...He does it himself, like he stands while he’s talking and yeah, it seems like a good option” (Pia, 31)

“I’m always standing up so I prefer to stand up” (Sharon, 36)

“I wouldn’t [stand up]. I’ve been on my feet all day, it’s the last thing I would want to do is stand up and watch TV or use the computer” (Rebecca, 46)

5.5. Discussion

The aim of the current study was to gain a better understanding of the influences on physical activity and sedentary behaviour in women living in socio-economically disadvantaged neighbourhoods and experiencing depressive symptoms. Furthermore, this study investigated women’s perceptions of the direction of relationships between physical activity and risk of depression, as well as sedentary behaviour and risk of depression. Finally, this study aimed to identify potential strategies that women suggest may help increase physical activity and reduce sedentary behaviour.

Little is known about the influences on physical activity and sedentary behaviour in socio-economically disadvantaged women, in particular those experiencing depressive symptoms. Furthermore, although relationships have been found between components of physical activity and risk of depression as well as relationships between sedentary behaviour and risk of depression, the reason for and direction of those relationships are not known. Finally, there is a significant gap in research identifying intervention strategies aimed at promoting physical
activity and reducing sedentary behaviour in socio-economically disadvantaged women. This is particularly important amongst women experiencing depressive symptoms, for whom reduction of sedentary behaviours/adoption of physical activity may offer substantial health benefits. Since qualitative methods are useful for investigating areas in which little is known, the qualitative design of this study was able to therefore provide valuable information and novel evidence regarding these important research gaps.

**Intra-personal influences on physical activity**

Considering that the quantitative findings in Chapter 4 indicated an inverse relationship between physical activity and risk of depression, the findings of the current study provided further evidence suggesting that the relationship between physical activity and depression may be bi-directional. That is, women found that physical activity reduced feelings of depression, enabling them to cope better and feel ‘happier’. However, when feeling severely depressed, women’s physical activity levels would in turn dramatically decrease as they struggled to undertake even their everyday activities, highlighting an additional barrier to physical activity that women at risk of depression face. As much research into the relationship between physical activity and depression has utilised cross-sectional study designs (Teychenne, Ball, & Salmon, 2008b), causality and the direction of relationships have often been unable to be determined. Therefore, the current study was able to contribute to the evidence base that suggests a reciprocal relationship may exist between physical activity and depression, at least according to the perceptions of women with depressive symptoms.
Consistent with previous qualitative (Ball et al., 2006; Juarbe, 1998) and quantitative (Brown et al., 2001b; Brownson et al., 2001) research into the correlates of physical activity amongst socio-economically disadvantaged women, time constraints were a barrier to physical activity mentioned by most women in this study. Working women as well as mothers in particular struggled to manage their time in order to include leisure-time physical activity in their day. Mothers tended to put their families’ needs before their own and often perceived their own physical activity as a low priority. This finding is consistent with previous research including that among women living in socio-economically disadvantaged neighbourhoods, which has found that women’s responsibilities as mothers greatly restrict time for their own leisure-time physical activity (Juarbe, 1998; Welch et al., 2009). Further, tiredness, due particularly to long working hours and family responsibilities, was mentioned by most women as a negative influence on physical activity in this study. Several previous studies of socio-economically disadvantaged women (Ball et al., 2006; Osuji et al., 2006) have found similar results. However, the current study also found that some women could overcome this barrier by focussing on the benefits of physical activity, such as increasing one’s energy.

**Social influences on physical activity**

The current study found that social support from friends and family was perceived to influence women’s physical activity in three ways; by increasing enjoyment, motivation, and opportunities to be active. Similarly, other studies have
highlighted the importance of a lack of social support as a key barrier to physical activity among socio-economically disadvantaged women. Brown et al. (2001b) found that only a quarter of socio-economically disadvantaged mothers reported having a friend or family member offer to mind their children to create an opportunity for them to be physically active, whilst just 5% of mothers had a family member or friend take over their chores. Additionally, previous research amongst socio-economically disadvantaged women (Osuji et al., 2006) found that having no one to exercise with was significantly associated with not meeting the physical activity recommendations. Furthermore, we previously found that being active with a family member was associated with lower odds of depression, among women (Teychenne, Ball, & Salmon, 2008a). Therefore, social support for physical activity may be an important component of physical activity interventions aimed at reducing the risk of depression.

**Physical environmental influences on physical activity**

As women were recruited from socio-economically disadvantaged neighbourhoods, it was not surprising that cost, neighbourhood safety and lack of access to facilities were mentioned as barriers to physical activity in this study. Although one previous qualitative study found that cost appeared not to be a major barrier to physical activity amongst disadvantaged women (Ball et al., 2006), the current study’s findings are consistent with other previous qualitative (Wilbur et al., 2002) and quantitative (Brown et al., 2001b) studies which found cost to be an influence on physical activity amongst socio-economically disadvantaged women.
While previous research amongst socio-economically disadvantaged women has found safety concerns to be a barrier to physical activity (Ball et al., 2006; Wilbur et al., 2002), studies examining the availability of facilities for physical activity have provided mixed results (Ball et al., 2006; Brownson et al., 2001; Wilbur et al., 2002), with one qualitative study finding that lack of facilities was not a major barrier to physical activity (Ball et al., 2006). However, that study included a sample of women from urban areas only and therefore did not consider rural women’s perspectives. The present study included rural women and while examining rural-urban differences was not a key aim, responses did seem to reflect particular barriers related to lack of facilities amongst rural women.

Perceiving negative atmospheres within sporting and fitness clubs was also expressed as a barrier to physical activity by women in this study. The notion of “male domination” in sports/physical activities was also found in a previous qualitative study amongst minority women (Tortolero et al., 1999).

**Intra-personal influences on sedentary behaviour**

Women in the current study commonly expressed how they used television to ease depressive symptoms by distracting their negative thoughts. This finding may be explained by the ‘distraction hypothesis’ (Greist et al., 1979), which has been proposed to explain the inverse association between physical activity and depression. The ‘distraction hypothesis’ suggests that improvements in mental well-being associated with physical activity are due to the diversion of negative
thoughts and unpleasant stimuli resulting from the activity (Greist et al., 1979). Thus, in light of the findings from the current study, it could be suggested that women engage in television viewing as a form of distraction from depressed emotions. As little research has considered the mechanisms underlying the relationship between television viewing and depression, further support for this hypothesis, for example obtained through intervention studies, is needed.

Women’s reports suggested that the direction of the relationship between television viewing and depression was unidirectional. That is, feeling depressed increased women’s levels of television viewing, however, television viewing did not increase women’s level of depressive symptoms. Three previous studies have assessed the association between television viewing and depression in adults (Dittmar, 1994; Kleinke, 1988; Sidney et al., 1996), with all three finding a positive association between television viewing and risk of depression. However, as those studies were cross-sectional in design, they were not able to provide information regarding the direction of the relationship i.e. whether television viewing was a cause or a consequence of depression.

The influence of childhood television habits on adulthood habits emerged as a theme in the current study. However, the level and direction of influence varied. For example, whilst some women mentioned that being restricted by their parents as a child had influenced them as an adult to watch less television, for some women this had the opposite effect, leading them to watch more television as an adult. These mixed patterns are consistent with findings from a previous
longitudinal study (Gordon-Larsen, Nelson, & Popkin, 2004), which tracked television viewing trends from adolescence to adulthood. That study found that 30% of females watched lower levels (≤14 hours per week) of television as adolescents and continued to watch lower levels as adults. However, 18% of females watched lower levels of television as adolescents but increased their television viewing (>14 hours per week) as adults. The reasons that childhood television habits appear to affect adult habits differentially requires further investigation.

Social influences on sedentary behaviour

Although having children was mentioned by mothers as a barrier to physical activity, mothers in the current study also suggested that having young children meant they watched less television. A perceived lack of time as well as the awareness of positive role modelling for their children were described as reasons for the lower levels of television viewing amongst mothers. One previous cross-sectional study examined the association between having children and sedentary behaviour (using accelerometers) amongst socio-economically disadvantaged women (Sanchez et al., 2008). Consistent with findings from this thesis, that study found that women with children were less likely to be sedentary when compared to women without children.

Environmental influences on sedentary behaviour

Women in this study reported enjoying watching television on cold/wet days, but felt guilty watching television on warm/sunny days. Although the weather is a
non-modifiable factor, this finding suggests that strategies to reduce television viewing amongst women experiencing depressive symptoms might focus particularly on the winter months. Furthermore, during winter less time is generally spent outdoors. This increases the risk of depression, as spending time outdoors (in natural light) has been found to provide mental health benefits due to increased serotonin synthesis (Young, 2007).

**Strategies to increase physical activity and reduce sedentary behaviour**

Several potential intervention strategies to increase physical activity were suggested by women in the current study. Women emphasised the promotion of support from family and friends as a strategy to increase physical activity, with other social support strategies such as recreational and support groups also identified. Several intervention studies designed to reduce the risk of depression through increasing physical activity in women have included aspects of social support such as group exercise programs (Anderson et al., 1999; Nabkasorn et al., 2005), coaching/supervisors (Brown et al., 2001a; Craft et al., 2007) and/or supportive phone calls (Brown et al., 2001a; Craft et al., 2007). Although these studies did not specifically target socio-economically disadvantaged women, most interventions adopting those strategies were effective in reducing depressive symptoms.

Although intervention evidence indicates that physical activity is beneficial in reducing the risk of depression (Asbury, Chandrruangphen, & Collins, 2006; Balkin et al., 2007), few studies have identified specific strategies to overcome
the physical activity barrier of feeling depressed. One intervention strategy that was frequently mentioned in the current study was a public awareness campaign that aims to increase women’s knowledge of the mental, as well as physical health benefits of physical activity. Using educational sessions and materials is a strategy that has been used in previous intervention studies aimed at increasing physical activity and reducing depressive symptoms amongst women (Brown et al., 2001a; Craft et al., 2007). Both interventions had relatively high adherence rates (83% and 75% respectively) and were successful in reducing depressive symptoms (Brown et al., 2001a; Craft et al., 2007). However, ‘education’ may need to be supplemented with other strategies, since generally reviews of intervention studies have shown that education alone is minimally effective (Kahn et al., 2002; King, Rejeski, & Buchner, 1998).

Learning to prioritize physical activity was a strategy that was suggested as important in the current study. This could be done through information sessions, counselling or print materials which are aimed at supporting women to overcome barriers to physical activity. Similar strategies have been used in previous intervention studies aimed at reducing the risk of depression through physical activity (Anderson et al., 1999; Brown et al., 2001a). Those studies demonstrated positive effects and high adherence rates amongst women (83-89%) indicating that providing information on overcoming barriers to physical activity may be an important component of a physical activity intervention for women with depressive symptoms. Further, the time management strategy of ‘multi-tasking’ was used by several women in order to increase their physical activity as well as
reduce sedentary behaviour. Multi-tasking, whereby a woman may be physically active at the same time as fulfilling a responsibility or household chore, was identified in a previous study of disadvantaged women as a practice used in order to deal with time pressure (Welch et al., 2009). It may be that with the increasing number of mothers entering/re-entering the workforce (Australian Bureau of Statistics, 1997), ‘multi-tasking’ may become an important strategy for many women to increase physical activity and reduce sedentary behaviour.

Other strategies mentioned by mothers in this study to increase physical activity included increasing the availability of short-term childcare facilities, support from friends and family to look after the children, as well as providing exercise classes for mothers (women and babies exercise groups). Previous research has found pram-walking exercise programs to be beneficial in improving physical fitness as well as reducing depressive symptoms in mothers suffering from postnatal depression (Armstrong & Edwards, 2003, 2004). Therefore, exercise classes for mothers with their babies may be a key strategy to increase physical activity and reduce the risk of depression in mothers with young children. However, among mothers with older children, this may not be as suitable, and alternate approaches may be required. Since several women discussed how they felt uncomfortable in gyms that were dominated by males, providing “women’s only” exercise classes and gyms may be a key strategy in promoting physical activity amongst women living in socio-economically disadvantaged areas. This strategy was also identified in a previous qualitative study which discussed potential strategies for increasing rural women’s physical activity (Eyler & Vest, 2002), finding that in
every focus group, women mentioned the need for a “women’s only” place to exercise (Eyler & Vest, 2002).

In this study, providing more facilities that are close to home, longer opening hours of facilities, cost-free activities as well as information on available facilities and classes were strategies that women discussed as potentially increasing their physical activity. One previous study that assessed the effectiveness of a physical activity intervention among mothers included the provision of print-based materials about leisure-time physical activity opportunities in their neighbourhood (Miller, Trost, & Brown, 2002). While the intervention was effective, that study also included other intervention strategies such as social support. Therefore, it is not known which component was most effective in increasing physical activity.

In the current study, women often misinterpreted the term ‘sedentary behaviour’ as ‘lack of physical activity’. This may be due to women being less exposed to the concept since sedentary behaviour has received significantly less social marketing and promotion than has physical activity. This highlights the importance of promoting and educating the public on the concept of sedentary behaviour and the health risks that may be linked to spending long periods engaged in sedentary behaviours, independent of physical activity. In light of this, very few strategies were mentioned by women that could be used to reduce sedentary behaviour. The concept of ‘multi-tasking’ was a time management strategy already used by women that reduced their sedentary behaviour. For example, women mentioned completing household chores (standing up) whilst watching television. Although
a perceived lack of time has been consistently reported as a barrier to women’s physical activity in previous studies (Ball et al., 2006; Brown et al., 2001b; Brownson et al., 2001), the findings of the current study illustrated how a lack of time may be a positive factor in reducing sedentary behaviour amongst women. As many women did not believe watching television whilst standing up was feasible, it may be that encouraging women to reduce sedentary behaviour by ‘multi-tasking’, rather than ‘standing as opposed to sitting’ could be a key strategy.

5.5.1. Limitations

Several limitations of this study should be acknowledged. Firstly, during interviews there is the possibility of socially desirable responses (e.g. women describing higher than actual levels of physical activity and lower levels of sedentary behaviour). However, most women provided detailed descriptions of their often low levels of physical and they were very open to discussing this and reasons for this, which suggests that socially desirable responses were minimal.

Secondly, socio-economic position was defined using an area-based measure. Therefore, a number of women were not considered to be socio-economically disadvantaged based on individual level indicators such as income or education (e.g. 28% of participants had completed a university degree). Nevertheless, area-based indicators are often used as proxy measures of socio-economic position and have been widely used in health research (Galobardes et al., 2006b). Area-based indicators of socio-economic position have also been linked to lower leisure-time
physical activity, independent of individual socio-economic indicators (van Lenthe, Brug, & Mackenbach, 2005). Furthermore, the current study managed to include a reasonable proportion of women with low individual socio-economic position as well as low area-based socio-economic position. Since we targeted a high risk and typically hard to reach group (socio-economically disadvantaged women at risk of depression), it was not surprising that the study had a low response rate (24%). Thus, themes identified in the current study may be limited and not apply widely to socio-economically disadvantaged women. However, our sample managed to include women from a range of backgrounds, including working mothers and clinically depressed, providing valuable insights relevant to this at-risk target group.

4.5.2. Strengths

A major strength of the current study was the qualitative design, which provided detailed insights not possible from quantitative approaches. Furthermore, women from both rural and urban areas of socio-economic disadvantage were included in this study. Socio-economically disadvantaged women are an important group for this research given that they are at risk of physical inactivity (Armstrong, Bauman, & Davies, 2000) and depression (Scarinci et al., 2002). Therefore this study was able to provide key insights into the influences on physical activity and sedentary behaviour, as well as identifying potential strategies to promote physical activity and reduce sedentary behaviour amongst an important target group. Further, since the interviews touched on sensitive issues such as depression, the use of telephone interviews allowed women to talk more openly
than may have been the case in a face-to-face situation (Dillman & Frey, 1974). Although telephone interviews generally have lower response rates than face-to-face interviews (Aday, 1996), telephone interviews have been shown to deliver valid responses as well allowing participants more flexibility, thus enabling the recruitment of those who may not be available for face-to-face interviews (Dillman & Frey, 1974).

4.5.3. Future research/implications

The findings of the current study suggested that women who are at risk of depression and live in socio-economically disadvantaged areas perceived that there are numerous intra-personal, social and physical environmental influences on their physical activity. Further, this study was able to provide valuable insights into the various intra-personal, social and physical environmental influences on sedentary behaviour amongst this target group.

Feeling depressed was described as both a barrier to physical activity as well as a predictor of sedentary behaviour (particularly television viewing), which highlights the importance of identifying targeted strategies to promote a healthy lifestyle (i.e. increasing physical activity and reducing sedentary behaviour) amongst women at risk of depression. Women with depressive symptoms suggested several strategies that could be used to increase physical activity and reduce sedentary behaviour. Strategies included providing information on available facilities, childcare, family and friend support, mother’s physical activity groups, women’s only gyms/classes and public awareness campaigns.
Since depression is the world’s most incapacitating illness (Lopez & Murray, 1998) and has been linked to low physical activity levels (Teychenne, Ball, & Salmon, 2008b) and greater time spent in sedentary behaviours (Sidney et al., 1996), research into strategies to promote healthy lifestyles in order to reduce the risk of depression is imperative. This study provided novel qualitative findings that could inform future intervention strategies to increase physical activity and reduce sedentary behaviour for women living in socio-economically disadvantaged areas and experiencing depressive symptoms, an important target group for such research.

Furthermore, insights from the current study were used to inform the development of Study 3 (Chapter 6). Although previous research has examined the possible determinants which may partially explain the socio-economic differences in women’s physical activity (Ball et al., 2007), further research is needed to understand the extent to which intra-personal, social and physical environmental correlates on sedentary behaviour may vary across socio-economic groups and whether these variations may explain the socio-economic differences in sedentary behaviour. The following chapter reports on a study that examined the intra-personal, social and physical environmental mediators of socio-economic inequalities in women’s sedentary behaviour (i.e. television viewing).
CHAPTER 6: Determinants of socioeconomic inequalities in women’s sedentary behaviour: a study of intra-personal, social and environmental mediators

6.1. Introduction

Compared with women of higher socio-economic position, socio-economically disadvantaged women are more likely to spend excess time engaged in television viewing and screen-based entertainment (King et al., 2010; Stamatakis et al., 2009) and thus are at high risk of sedentary-related diseases such as depression (Hobfoll et al., 1995; Lorant et al., 2003) and obesity (McLaren, 2007). However, currently the determinants of this socio-economic gradient in sedentary behaviour are not known. Since socio-economic differences in television viewing parallel the socio-economic gradients in many health outcomes, it is important to understand which factors may explain the inverse relationship between socio-economic position (i.e. education) and television viewing.

To the candidate’s knowledge, no previous studies have investigated mediators of socio-economic inequalities in television viewing amongst adults. However, insights provided from the literature review in Chapters 2 and 3 as well as the qualitative study in Chapter 5 may shed some light on potential mediators of socio-economic position-television viewing associations. Much like physical activity, the correlates of sedentary behaviours such as television viewing can be described in terms of intra-personal, social, and physical environmental factors, following the social ecological framework of human behaviour (Sallis & Owen,
1999). From previous literature, intra-personal factors positively associated with excess television viewing amongst adults included weight/BMI (Cleland et al., 2008b; Duvigneaud et al., 2007), energy intake/food consumption (Cleland et al., 2008b; Jeffery & French, 1998), body dissatisfaction (Williams et al., 1999), and depression (Sidney et al., 1996). Further, experiencing higher levels of stress and poor general health are more prevalent amongst adults of a low socio-economic position (Marmot et al., 1991; Stronks et al., 1998), and both stress and poor health have been reported as barriers to physical activity amongst women (Azar et al., 2010; Osuji et al., 2006) in physical activity literature, warranting research testing these possible mediators of the socio-economic gradient in sedentary behaviour (e.g. television viewing).

Few studies have assessed social factors associated with television viewing. However, one cross-sectional study amongst female university students (Williams et al., 1999) found that social support for physical activity was inversely associated with hours spent in television viewing. Further, the qualitative findings presented in Chapter 5 showed that childhood television habits and having children were perceived as influences on television viewing by women living in disadvantaged neighbourhoods with depressive symptoms. Other social factors such as interpersonal trust (an indicator of perceived social capital (Ball et al., 2010)) and social cohesion (defined as an absence of conflict within society, as well as sharing common values (Kearns & Forrest, 2000)), have been found to predict physical activity in physical activity research. However, it is not known whether these factors predict sedentary behaviour, and moreover, whether these
factors play a role in mediating the socio-economic gradient in sedentary behaviour. Very few studies have assessed physical environmental correlates of television viewing. However, one study that assessed the walkability of the neighbourhood in relation to television viewing (Sugiyama et al., 2007) found that neighbourhood walkability was negatively associated with television viewing in women. In other words, women who lived in a neighbourhood that encouraged walking (e.g. living near shops) were less likely to watch television than those who lived in less walkable neighbourhoods. Possibly, neighbourhoods which encourage walking/physical activity lead to greater physical activity participation, which may displace time spent watching television.

As mentioned in Chapter 5, little research has assessed the intra-personal, social and physical environmental factors associated with television viewing in women. Furthermore, the extent to which these factors may vary across socio-economic groups, and whether these variations may explain the socio-economic differences in television viewing, are unknown. The current chapter presents the findings of a study examining whether intra-personal, social and physical environmental factors mediate (i.e. partly explain) associations between socio-economic position and women’s television viewing. Understanding the mechanisms underlying associations between socioeconomic position and television viewing is important in order to identify potential target points for interventions aimed at reducing the socio-economic gradient in television viewing, and in turn reducing the risk of sedentary-related disease amongst socio-economically disadvantaged groups.
6.2. Aims and hypotheses

The aim of the current study was to examine whether intra-personal, social and physical environmental factors mediate the associations between socio-economic position and women’s television viewing. Based on the review of the literature (Chapter 3), as well as findings from Chapter 5, it was hypothesised that a number of intra-personal (e.g. enjoyment of television viewing, self-efficacy for walking, preference for sedentary behaviour, depressive symptoms and weight status), social (e.g. social participation, social support from friends and family, interpersonal trust and social cohesion) and physical environmental factors (e.g. neighbourhood aesthetics, perceived safety and perceived distance to physical activity facilities) would mediate the relationship between women’s socio-economic position (education) and television viewing.

6.3. Methods

The present study involved secondary statistical analysis of cross-sectional survey data collected in the ‘SocioEconomic Status and Activity in Women’ (SESAW) study of 2004 (Ball, Crawford, & Mishra, 2006; Ball et al., 2007). The SESAW study collected information from women aged between 18 and 65, including data on the women’s physical activity, sedentary behaviour, mental health and socio-demographic details.

6.3.1. Participants

Participants in the SESAW study were recruited from 45 Melbourne suburbs with varying levels of socioeconomic disadvantage, based on the Australian Bureau of
Statistics SEIFA - Socioeconomic Index for Areas (Australian Bureau of Statistics, 2003) (see section 4.3.1 for further details). Fifteen suburbs were randomly selected from each of the lowest, middle and highest socio-economic septiles, and the electoral roll was then used to randomly select women between the ages of 18 and 65 years living in those areas. There was a slight over sampling of women from low and mid socioeconomic status relative to high (ratio 1.5: 1.2: 1) to counter low response rates typically observed in low socioeconomic status groups (Sheikh & Mattingly, 1981).

Two separate samples of women were sent either a physical activity survey (n=2,400) or a healthy eating survey (n=2,400) and those who responded were given the opportunity to complete the alternative survey. Of those who were sent the physical activity survey, 1,045 women responded initially. Of those who were sent the healthy eating survey initially, 509 women also completed the physical activity survey. Therefore, a total of 1554 women completed the SESAW survey on physical activity. Although non-respondents to both surveys were generally more likely to live in areas of low SEIFA, there was a good spread across all SEIFA levels amongst respondents (497 from high-, 577 from mid-, and 466 from low-SES neighbourhoods). Of the resulting sample of 1554 women, a total of 14 women were excluded from analyses due to having recently moved out of the study neighbourhoods. Additionally, only non-pregnant women were included in this study (n = 1,491). This left a total of 1,479 women whose data were included in the analyses (since two women who had moved were also pregnant).
6.3.2. Ethics

Ethical approval from the Deakin University Human Research Ethics Committee was obtained for the SESAW study on which the analyses for this study are based (EC 26-2002). No further ethics approval was needed for this study.

6.3.3. Procedures

Women selected for the surveys were sent a pre-survey letter in the mail, informing them that they had been selected to take part in a study on women’s health and that the survey would be sent to them shortly. Surveys were posted out to the selected women one week later. Following the Dillman protocol (Dillman, 1978), non-respondents received a mailed reminder within three weeks and a second reminder with a replacement survey package a further three weeks later. Women received small incentives (e.g. tea bags, $1 scratchies\(^2\)) with their initial survey package.

6.3.4. Measures

The SESAW Physical Activity survey, consisting of 109 questions, was administered by mail and included self-report measures of sociodemographic characteristics, physical activity, sedentary behaviour and depressive symptoms (see Appendix 31). The key variables related to the social ecological model (Sallis & Owen, 1999) were included in this study and are described below.

\(^2\) Scratchies: Small cardboard lottery tokens which are scratched in order to win/reveal a cash prize
6.3.4.1. Predictor variable

Highest educational level (No formal qualification; Up to year 10; year 12 or equivalent; trade/apprenticeship; certificate/diploma; university degree; higher university degree) was used as an indicator of individual socio-economic position. Education is a useful indicator of women’s socio-economic position since it is relatively stable across adult life (compared with occupation and income which are less stable during childbearing years particularly). Responses were collapsed into three categories; no formal qualifications/up to year 10; year 12/trade/apprenticeship/certificate/diploma; university degree/higher degree.

6.3.4.2. Outcome variable: Television viewing

In order to assess time spent in television viewing, participants were asked to estimate the number of hours and minutes they spent watching television on a usual weekday, as well as a weekend day (in the past seven days). For example; “Of your total sitting time, during the last 7 days, how much time did you usually spend sitting watching TV on a weekday?” and “Of your total sitting time, during the last 7 days, how much time did you usually spend sitting watching TV on a weekend day?” This measure has been found to be valid ($r = 0.3$, $p<0.01$) and reliable (ICC = 0.82) in an Australian adult population (Salmon et al., 2003).

Management of television viewing scores

Weekly time spent watching television was calculated by multiplying the duration of television viewing on weekdays by five (days) then adding this to the weekend days total duration (duration multiplied by two [days]). Data for weekly television
viewing time were truncated at 126 hours (0.1%). This cut-point was based on an internally-developed protocol used by the researches from the Centre for Physical Activity and Nutrition (Deakin University). Weekly television viewing was analysed as a continuous variable (range = 0-126 hours).

6.3.4.3. Intra-personal mediators

The internal consistency (Cronbach’s) of scaled items was defined as acceptable if Cronbach’s alpha score was greater than 0.6 (Sim & Wright, 2000). Intraclass correlations (ICC’s) were used to determine the test-retest reliability of measures (Streiner & Norman, 1989). Test-retest reliability for continuous variables was deemed as adequate if ICC ≥ 0.75 (Sim & Wright, 2000). Eight potential intra-personal mediators were assessed.

Enjoyment of television viewing

Enjoyment of television viewing was assessed using a modified scale (Kendzierski & DeCarlo, 1991), which included 10 sets of opposing statements, each with a seven-point response scale, related to the feelings about television viewing (e.g. 1 “I enjoy it” to 7 “I hate it”; 1 “I find it energizing” to 7 “I find it tiring”). The enjoyment of television viewing (Cronbach’s = 0.92; ICC = 0.83) responses were summed and analysed as a continuous variable (range = 10-70).

Self-efficacy for walking

Self-efficacy for walking was assessed using a modified physical activity measure (Marcus et al., 1992). Respondents reported on a 5-point Likert scale (not at all
confident to extremely confident), their confidence of walking in five situations (when I am tired; when I am in a bad mood; when I feel I don’t have time; when I am on holidays; and when it is raining). Self efficacy (Cronbach’s = 0.86; ICC = 0.85) responses were summed and analysed as a continuous variable (range = 5-25).

Preference for sedentary behaviour
Preference for leisure-time sedentary behaviour was assessed using a four-item measure, shown to have good reliability (ICC = 0.75) (Salmon et al., 2003). Participants were asked to indicate which type of activity (vigorous, moderate or sedentary activity) they would “most prefer” doing in various contexts (e.g. before work, during lunch breaks, after work, on the weekend). Responses were summed with a minimum count of 0 and maximum count of 4 for each activity (i.e. vigorous, moderate, or sedentary). Preference for sedentary behaviour was then analysed as a continuous variable (range = 0-4).

Barriers to physical activity: Feeling self-conscious and poor health
Perceived barriers to being physically active, which included feeling self-conscious and not being in good health, were measured using items adapted from published scales (Brownson et al., 2001). Participants were required to rate on a 5-point Likert scale how often these two barriers prevented them from being physically active (never to very often). Responses were then collapsed into three categories (‘never/rarely’, ‘sometimes’, and ‘often’) for each of these items.
Depressive Symptoms

Mental health characteristics of participants were measured using the 30-item version of the General Health Questionnaire (Goldberg, 1972). This includes questions relating to symptoms of depression experienced in the last couple of weeks as indicators of risk of poor mental health. The measurement properties of this tool have been widely reported and it has been found to provide an accurate prediction of those at risk of depression (Goldberg & Williams, 1988). In this method, respondents rated themselves on a 3-point severity scale. Examples of questions included: “Have you recently been able to concentrate on whatever you’re doing?” (better than usual (0); same as usual (0); less than usual (1)); “Have you recently lost much sleep over worry?” (not at all (0); no more than usual (0); rather more than usual (1)); “Have you recently been able to enjoy your normal day-to-day activities?” (more so than usual (0); same as usual (0); less so than usual (1)). Total GHQ-30 scores were analysed as a continuous variable (range = 0-30), with greater scores indicating greater presence of depressive symptoms (Goldberg & Williams, 1988).

Stress

Level of stress was assessed using a four-item measure of the Perceived Stress Scale (PSS) (Cohen, Kamarck, & Merelstein, 1983). Questions related to feelings of stress experienced in the last month and participants reported on a 5-point Likert scale (Never to Always) as to how often they felt such feelings (e.g. “How often is the last month have you felt that you were unable to control the
important things in your life?”). Responses were summed and analysed as a continuous variable (Cronbach’s = 0.69; ICC = 0.64; range = 4-20).

Weight status

Participants’ weight status (Body Mass Index [BMI]) was assessed through self-reported height and weight and analysed as a continuous variable.

6.3.4.4. Social Mediators

Four potential social mediators were assessed in this study.

Social participation

Social participation was assessed using a 13-item measure adapted from Baum (1999). Participants were asked to report on a 5-point scale ranging from ‘not at all’ to ‘more than twice a month’ how frequently they participated in social activities (e.g. ‘visited family or had family visit’; ‘been involved in a hobby group’). Responses for each question were coded (1 = low level of social participation to 4 = high level of social participation) then summed and analysed as a continuous variable (range = 14-52), with greater scores indicating greater social participation (ICC = 0.73).

Social support from family and friends

Social support for physical activity was measured using two items adapted from published scales (Sallis et al., 1987). Participants were asked to report on a 5-point scale ranging from ‘never’ to ‘very often’ (subsequently collapsed into three
categories: never/rarely, sometimes, or often), how frequently they participated in physical activity with family and with friends/coworkers in the past year.

**Interpersonal trust**

Interpersonal trust is an indicator of perceived social capital, a construct found to predict physical activity (Ball et al., 2010). Interpersonal trust was assessed using two items which asked participants to rate on a 5-point Likert scale how strongly they agree (1 = strongly disagree to 5 = strongly agree) with the statements “Most people can be trusted” and “Most of the time people try to be helpful” (Lochner, Kawachi, & Kennedy, 1999). Responses were summed and then analysed as a continuous variable (range = 2-10), with greater scores indicating greater interpersonal trust (ICC = 0.75).

**Social cohesion**

Perceived social cohesion within the community was assessed using a five-item measure which asked participants to rate on a 5-point Likert scale how strongly they agree (1 = strongly disagree to 5 = strongly agree) with the following five statements: “People in the neighbourhood can be trusted”; “This is a close-knit neighbourhood”; “People around here are willing to help their neighbours”; “People in this neighbourhood don’t generally get along with each other”; and “People in this neighbourhood do not share the same values” [the last two statements were reverse coded] (Sampson, Raudenbush, & Earls, 1997). Scores were summed and then analysed as a continuous variable (range = 6-25), with greater scores indicating greater social cohesion (ICC = 0.85).
6.3.4.5. Physical environmental mediators

Four potential physical environmental mediators were assessed in this study.

*Neighbourhood aesthetics*

Perceived neighbourhood aesthetics were measured with three items (Giles-Corti & Donovan, 2002). Participants were asked to indicate on a 5-point Likert scale how strongly they agree (1 = strongly disagree to 5 = strongly agree) with the three statements “My neighbourhood is attractive; there are interesting walks to do; my neighbourhood is well maintained”. Scores were summed (Cronbach’s = 0.89; ICC = 0.90) and then analysed as a continuous variable (range = 3-15), with greater scores indicating better perceived neighbourhood aesthetics.

*Perceived safety*

Perceived safety in the neighbourhood was assessed with three items. Participants were asked to indicate on a 5-point Likert scale how strongly they agree (1 = strongly disagree to 5 = strongly agree) with the three statements “My neighbourhood is safe for walking; it is safe out walking day or night; the streets are well lit at night” (Giles-Corti & Donovan, 2002) Scores were summed and then analysed as a continuous variable (range = 3-15), with greater scores indicating greater perceived safety (Cronbach’s = 0.73; ICC = 0.80).
Perceived distance to places of interest and physical activity facilities

Perceived distance to places of interest was assessed using a nine-item measure in which participants were asked to indicate whether a variety of places of interest were walking distance from home (0 = no/don’t know; 1 = yes). Places of interest included: clothing shops, schools, chemists/pharmacies, banks, playgrounds, libraries, video stores, movie cinema, milk bar. Perceived distance to physical activity facilities was assessed using a 10-item measure in which participants were asked to indicate whether a variety of places to be active/facilities were walking distance from home (0 = no/don’t know; 1 = yes). Places to be active included: beach, golf course, gym/health centre, public open space, walking/bike paths, river, public swimming pool, public tennis courts, squash courts, indoor sports courts.

The number of ‘yes’ responses for both the perceived distance to places of interest (ICC = 0.97) and perceived distance to physical activity facilities (ICC = 0.83) were summed and then analysed as two continuous variables (ranges = 0-9 and 0-10 respectively) with greater scores indicating a greater number of facilities and places of interest within walking distance.

6.3.5. Covariates

Marital status (categorised as married or defacto; separated, widowed or divorced; never married) and children living at home (categorised as yes or no), were included in single and multiple mediating analyses as potentially confounding factors, as these variables were bivariately associated with television viewing.
Other variables that were tested but found not to be associated with the outcome variable included long-term illness/injury (whether or not respondents reported the presence of a long-term illness or disability that prevents them from being active), age (Under 30; 30-39; 40-49; 50 years and over), household income (up to $699 per week; $700 to $999 per week; $1000 to $1499 per week; $1500 or more per week; don’t know/don’t want to answer/missing), employment status (categorised as working full-time; part-time; unemployed/laid off; keeping house/raising children full-time; looking for work; studying full-time; retired) and country of birth.

6.3.6. Statistical analyses

Analyses were performed using STATA version 11.0. Descriptive and unilevel analyses were used to initially examine the distributions of, and bivariate associations between, television viewing, demographic, socio-economic and mediator variables. MacKinnon’s product of coefficients test of statistical mediation was used to test mediation, since it has been shown that this method has greater statistical power than other mediating methods (MacKinnon et al., 2002), such as Baron and Kenny’s approach (Baron & Kenny, 1986). After testing the distributions of the television viewing variable for normality (and subsequently transforming these to be as close as possible to a normal distribution using either a square root or log transformation), a linear regression model (i.e. single mediating analysis) was used to bivariately estimate intra-personal, social and physical environmental mediators of associations between socio-economic position and women’s television viewing, controlling for clustering by
neighbourhood of residence (due to the sampling of women from selected suburbs). This was performed by following MacKinnon’s product of coefficients formula \( z = \frac{\alpha \beta}{\text{SE} \alpha \beta} \), whereby \( \alpha \) = the relationship between the independent variable (education) and the mediator, \( \beta \) = the relationship between the mediator and the dependent variable (television viewing), and \( \text{SE} \alpha \beta \) = the standard error of the product of \( \alpha \) and \( \beta \) (MacKinnon et al., 2002). A z-score greater than the absolute value of 1.96 (i.e. greater than 1.96 or less than -1.96) was used to indicate a statistically significant mediating association. Following this, a multiple mediation analysis was performed, and only the proposed mediators that were found to be significantly associated with television viewing in single mediating analyses were included in the multiple mediation model.

6.4. Results

6.4.1. Characteristics of the sample

The final sample consisted of 1,479 women. Table 6.1 presents the socio-demographic characteristics of participants. The mean age of participants was 42 years (SD = 12.78). Just under one quarter of women (23%) reported not completing high school, with 41% of women reporting their highest qualification as completing high school or an apprenticeship or certificate/diploma. The majority of participants were born in Australia (74%) and were married or in a defacto relationship (64%). A total of 212 (14%) women reported a weekly household income of under $700 with nearly a quarter of women (21%) reporting a weekly household income of $1500 or more. A total of 559 participants reported working full-time (38%) and a quarter reported working part-time. A total of 223
(15%) women reported suffering from a long term illness/injury that prevented them from being physically active and 601 (40%) women reported having children living at home.
Table 6.1 Frequencies of socio-demographic characteristics amongst women in the SESAW study (n=1,479)

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>N</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Highest Qualification</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Did not complete high school</td>
<td>329</td>
<td>23</td>
</tr>
<tr>
<td>High school/trade apprentice/Certificate diploma</td>
<td>595</td>
<td>41</td>
</tr>
<tr>
<td>University or Higher degree</td>
<td>539</td>
<td>37</td>
</tr>
<tr>
<td><strong>Age</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Under 30 yrs</td>
<td>299</td>
<td>21</td>
</tr>
<tr>
<td>30 to 39 yrs</td>
<td>356</td>
<td>24</td>
</tr>
<tr>
<td>40 to 49 yrs</td>
<td>348</td>
<td>24</td>
</tr>
<tr>
<td>50+ yrs</td>
<td>454</td>
<td>31</td>
</tr>
<tr>
<td><strong>Country of birth</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Australia</td>
<td>1097</td>
<td>74</td>
</tr>
<tr>
<td>UK</td>
<td>59</td>
<td>4</td>
</tr>
<tr>
<td>Italy</td>
<td>23</td>
<td>1</td>
</tr>
<tr>
<td>Greece</td>
<td>24</td>
<td>2</td>
</tr>
<tr>
<td>New Zealand</td>
<td>9</td>
<td>1</td>
</tr>
<tr>
<td>Vietnam</td>
<td>30</td>
<td>2</td>
</tr>
<tr>
<td>Other</td>
<td>235</td>
<td>16</td>
</tr>
<tr>
<td><strong>Marital Status</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Married or defacto</td>
<td>937</td>
<td>64</td>
</tr>
<tr>
<td>Separated widowed or divorced</td>
<td>197</td>
<td>13</td>
</tr>
<tr>
<td>Never married</td>
<td>334</td>
<td>23</td>
</tr>
<tr>
<td>Characteristic</td>
<td>N</td>
<td>Percent</td>
</tr>
<tr>
<td>----------------------------------------------</td>
<td>-----</td>
<td>---------</td>
</tr>
<tr>
<td><strong>Children living at home (up to 18 yrs)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>601</td>
<td>40</td>
</tr>
<tr>
<td>No</td>
<td>888</td>
<td>60</td>
</tr>
<tr>
<td><strong>Household income</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Up to $699 per week</td>
<td>212</td>
<td>14</td>
</tr>
<tr>
<td>$700-999 per week</td>
<td>151</td>
<td>10</td>
</tr>
<tr>
<td>$1000-1499 per week</td>
<td>202</td>
<td>14</td>
</tr>
<tr>
<td>$1500 or more per week</td>
<td>315</td>
<td>21</td>
</tr>
<tr>
<td>Other (Don’t know/want to answer)</td>
<td>609</td>
<td>41</td>
</tr>
<tr>
<td><strong>Employment status</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Working full-time</td>
<td>559</td>
<td>38</td>
</tr>
<tr>
<td>Working part-time</td>
<td>359</td>
<td>25</td>
</tr>
<tr>
<td>Unemployed/laid off</td>
<td>31</td>
<td>2</td>
</tr>
<tr>
<td>Looking for work</td>
<td>25</td>
<td>2</td>
</tr>
<tr>
<td>Keeping house/raise children</td>
<td>254</td>
<td>17</td>
</tr>
<tr>
<td>Studying full-time</td>
<td>95</td>
<td>6</td>
</tr>
<tr>
<td>Retired</td>
<td>142</td>
<td>10</td>
</tr>
<tr>
<td><strong>Long term illness/injury?</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>223</td>
<td>15</td>
</tr>
<tr>
<td>No</td>
<td>1252</td>
<td>85</td>
</tr>
</tbody>
</table>

**6.4.2. Single mediating analyses**

The mean duration per week of time spent sitting watching television by women was just under 21 hours (Mean = 20.94, SD = 19.72). Socio-economic position
(education) was inversely associated with women’s television viewing (regression coefficient ($\tau$) = -0.48; 95% CI = -0.62, -0.33). Single mediating analyses were performed in order to identify the intra-personal, social and physical environmental factors which mediated the relationship between women’s television viewing and socio-economic position (education).

6.4.2.1. Intra-personal mediators

Table 6.2 presents the bivariable associations between socio-economic position (i.e. education), and intra-personal factors hypothesised to mediate the relationship between socio-economic position and television viewing. As shown, enjoyment of television viewing and weight status (BMI) were significant mediators of socio-economic variations in television viewing. For example, women who reported a high education reported lower levels of enjoyment of television viewing (though not statistically significantly); and those who reported lower levels of enjoyment of television viewing reported lower levels of television viewing. Further, women who reported a high education generally had a lower BMI, and those with a lower BMI reported watching lower levels of television. However, preference for sedentary behaviour, stress, self-efficacy for walking, feeling self-conscious and poor health were not found to be significant intra-personal mediators of socio-economic variations in television viewing.
Table 6.2 Potential intra-personal mediators† from single mediating analyses explaining the association between socio-economic position and television viewing amongst women

<table>
<thead>
<tr>
<th>Intra-personal mediators</th>
<th>$\alpha$ (95% CI)</th>
<th>$\beta$ (95% CI)</th>
<th>$a\beta$</th>
<th>SE$a\beta$</th>
<th>z-score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Enjoyment of TV viewing</td>
<td>-1.76 (-2.77, -0.75)</td>
<td>0.03 (0.02, 0.04)</td>
<td>-0.057</td>
<td>0.02</td>
<td>-3.12*</td>
</tr>
<tr>
<td>Preference for sedentary behaviour</td>
<td>-0.02 (-0.07, 0.02)</td>
<td>0.19 (0.03, 0.36)</td>
<td>-0.006</td>
<td>0.00</td>
<td>-1.24</td>
</tr>
<tr>
<td>Stress</td>
<td>-0.68 (-0.91, -0.45)</td>
<td>0.00 (-0.03, 0.03)</td>
<td>-0.000</td>
<td>0.01</td>
<td>-0.03</td>
</tr>
<tr>
<td>Self-efficacy for walking</td>
<td>0.89 (0.51, 1.26)</td>
<td>-0.02 (-0.04, 0)</td>
<td>-0.019</td>
<td>0.01</td>
<td>-1.9</td>
</tr>
<tr>
<td>Feeling self-conscious</td>
<td>-0.07 (-0.11, -0.02)</td>
<td>0.13 (-0.04, 0.29)</td>
<td>-0.008</td>
<td>0.01</td>
<td>-1.4</td>
</tr>
<tr>
<td>Poor health</td>
<td>-0.10 (-0.16, -0.03)</td>
<td>0.03 (-0.14, 0.21)</td>
<td>-0.003</td>
<td>0.01</td>
<td>-0.36</td>
</tr>
<tr>
<td>Weight status (BMI)</td>
<td>-0.04 (-0.06, -0.03)</td>
<td>1.23 (0.79, 1.68)</td>
<td>-0.053</td>
<td>0.02</td>
<td>-3.43*</td>
</tr>
<tr>
<td>Depression</td>
<td>-0.08 (-0.19, 0.02)</td>
<td>-0.05 (-0.13, 0.02)</td>
<td>0.004</td>
<td>0.00</td>
<td>1.1</td>
</tr>
</tbody>
</table>

*p<0.05
† Adjusted for marital status and children, and clustering by neighbourhood

6.4.2.2. Social mediators

Table 6.3 presents the bivariable associations between socio-economic position (i.e. education), and social factors hypothesised to mediate the relationship between socio-economic position and television viewing. As shown, social cohesion, social participation and social support from friends were significant mediators of socio-economic variations in television viewing. For example, women who reported a high education reported greater levels of social cohesion, social participation and social support from friends; and those who reported greater levels of social cohesion, social participation or social support from friends reported lower levels of television viewing. However, interpersonal trust and social support from family were not found to be significant social mediators of socio-economic variations in television viewing.
Table 6.3 Potential social mediators† from single mediating analyses explaining the association between socio-economic position and television viewing amongst women

<table>
<thead>
<tr>
<th>Social mediators</th>
<th>α (95% CI)</th>
<th>β (95% CI)</th>
<th>αβ</th>
<th>SEαβ</th>
<th>z-score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Social cohesion</td>
<td>0.46 (0.24, 0.68)</td>
<td>-0.04 (-0.07, -0.01)</td>
<td>-0.018</td>
<td>0.01</td>
<td>-2.4*</td>
</tr>
<tr>
<td>Interpersonal trust</td>
<td>3.79 (2.49, 5.09)</td>
<td>-0.00 (-0.01, 0)</td>
<td>-0.019</td>
<td>0.01</td>
<td>-1.69</td>
</tr>
<tr>
<td>Social participation</td>
<td>0.06 (0.04, 0.07)</td>
<td>-0.51 (-1.01, -0.02)</td>
<td>-0.030</td>
<td>0.02</td>
<td>-1.98*</td>
</tr>
<tr>
<td>Social support from family</td>
<td>0.07 (0.01, 0.13)</td>
<td>-0.06 (-0.19, 0.06)</td>
<td>-0.005</td>
<td>0.01</td>
<td>-0.96</td>
</tr>
<tr>
<td>Social support from friends</td>
<td>0.11 (0.06, 0.17)</td>
<td>-0.30 (-0.42, -0.19)</td>
<td>-0.034</td>
<td>0.01</td>
<td>-3.1*</td>
</tr>
</tbody>
</table>

*p<0.05
† Adjusted for marital status and children and clustering by neighbourhood

6.4.2.3. Physical environmental mediators

Table 6.4 presents the bivariable associations between socio-economic position (i.e. education), and physical environmental factors hypothesised to mediate the relationship between socio-economic position and television viewing. No physical environmental factors were found to be significant mediators of socio-economic variations in television viewing.
Table 6.4 Potential physical environmental mediators† from single mediating analyses explaining the association between socio-economic position and television viewing amongst women

<table>
<thead>
<tr>
<th>Physical environmental mediators</th>
<th>α (95% CI)</th>
<th>β (95% CI)</th>
<th>αβ</th>
<th>SEαβ</th>
<th>z-score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Safety</td>
<td>0.20 (-0.03, 0.43)</td>
<td>-0.02 (-0.05, 0.02)</td>
<td>-0.003</td>
<td>0.00</td>
<td>-0.82</td>
</tr>
<tr>
<td>Aesthetics</td>
<td>13.96 (7.30, 20.62)</td>
<td>-0.00 (0, 0)</td>
<td>-0.03</td>
<td>0.02</td>
<td>-1.67</td>
</tr>
<tr>
<td>Distance to places of interest</td>
<td>1.20 (-0.32, 4.31)</td>
<td>-0.00 (-0.01, 0)</td>
<td>-0.003</td>
<td>0.00</td>
<td>-0.67</td>
</tr>
<tr>
<td>Distance to PA facilities</td>
<td>0.55 (0.33, 0.77)</td>
<td>0.04 (-0.02, 0.10)</td>
<td>0.024</td>
<td>0.02</td>
<td>1.36</td>
</tr>
</tbody>
</table>

*p<0.05
† Adjusted for marital status and children and clustering by neighbourhood

6.4.3. Multiple mediating analyses

Multiple mediating analyses were performed by entering into the model only those proposed mediators that were found to be significantly associated with television viewing in single mediating analyses (i.e. enjoyment of television viewing; weight status (BMI); social cohesion; social participation; and social support from friends). Covariates were also adjusted for in this model. Two intrapersonal factors (enjoyment of television viewing and weight status [BMI]) and two social factors (social cohesion and support from friends) remained significant mediators of socio-economic variations in television viewing. However, social participation did not remain significant in the full model (see Table 6.5).
### Table 6.5 Intra-personal and social mediators† from multiple mediating analyses explaining the association between socio-economic position and television viewing amongst women

<table>
<thead>
<tr>
<th>Mediators</th>
<th>$\alpha$ (95% CI)</th>
<th>$\beta$ (95% CI)</th>
<th>$a\beta$</th>
<th>SE$\alpha$</th>
<th>z-score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Enjoyment of TV viewing</td>
<td>-1.76 (-2.77, 0.75)</td>
<td>0.03 (0.02, 0.04)</td>
<td>-0.058</td>
<td>0.02</td>
<td>-3.11*</td>
</tr>
<tr>
<td>Body Mass Index (BMI)</td>
<td>-0.04 (-0.06, -0.03)</td>
<td>-1.10 (0.58, 1.61)</td>
<td>-0.05</td>
<td>0.02</td>
<td>-3.05*</td>
</tr>
<tr>
<td>Social cohesion</td>
<td>0.46 (0.24, 0.68)</td>
<td>-0.06 (-0.10, -0.02)</td>
<td>-0.028</td>
<td>0.01</td>
<td>-2.62*</td>
</tr>
<tr>
<td>Social participation</td>
<td>0.06 (0.04, 0.07)</td>
<td>-0.06 (-0.68, 0.55)</td>
<td>-0.004</td>
<td>0.02</td>
<td>-0.20</td>
</tr>
<tr>
<td>Social support from friends</td>
<td>0.11 (0.06, 0.17)</td>
<td>-0.25 (-0.39, -0.11)</td>
<td>-0.029</td>
<td>0.01</td>
<td>-2.63*</td>
</tr>
</tbody>
</table>

*p<0.05
† Adjusted for marital status and children and clustering by neighbourhood

### 6.5. Discussion

The aim of the current study was to examine the role of several intra-personal, social and physical environmental factors in mediating socio-economic gradient in women’s television viewing using cross-sectional data from a large population-based cohort of women aged 18-65, and living in suburbs of varying levels of disadvantage in Melbourne. The current study is consistent with previous literature in that education was strongly inversely associated with television viewing in adult women (Clark et al., 2010; Sidney et al., 1996), further emphasising the need to understand the underlying mechanisms that mediate this relationship. A major finding of this study is that in contrast to the initial hypotheses, the relationship between women’s socio-economic position (education) and television viewing was partly mediated by selected intra-personal and social factors, but not by physical environmental factors. Although it is possible that there may be other environmental factors not measured in this study.
that may mediate socio-economic inequalities in television viewing, the findings of this study suggest that other factors outside of the physical environment may be more important, and that interventions aimed at reducing the socio-economic inequalities in television viewing amongst women may need to focus on intra-personal and social influences.

**Intra-personal mediators of socio-economic inequalities in television viewing**

**Enjoyment of television**

The current study found the relationship between socio-economic position (education) and television viewing was partly mediated by women’s enjoyment of television viewing. Specifically, it was found that women of a low socio-economic position reported that they enjoyed watching television more than women of a high socio-economic position. Although the relationship between socio-economic position and enjoyment of television viewing has not been assessed previously, similar trends have been found in the physical activity literature (Ball et al., 2007). For example, one study found that the relationship between socio-economic position (education) and leisure-time walking was partly mediated by women’s enjoyment of walking, with women of a high socio-economic position enjoying walking more than women of a low socio-economic position (Ball et al., 2007). In light of these findings, it is apparent that socio-economically disadvantaged women are more likely to enjoy and therefore take part in sedentary behaviours such as television viewing during leisure-time, whilst women of a high socio-economic status may be more likely to enjoy and take part in physical activities such as walking during leisure-time.
Implications of the findings from the current study may be shaped by insights from qualitative work conducted in Chapter 5. That study showed that socio-economically disadvantaged women commonly expressed how they used television to relax and “switch off”. Therefore, providing socio-economically disadvantaged women with enjoyable alternatives for relaxation may be an important strategy to reduce the gradient between socio-economic position and television viewing. Enjoyable relaxation alternatives may include activities such as meditation, yoga, stretching, gardening or walking. These light-intensity activities are more commonly reported by adults than vigorous-intensity physical activities such as running or aerobics (U.S Department of Health and Human Services, 1996), and such light-intensity activities may be more likely to be enjoyed, adopted and maintained by disadvantaged sedentary women (Sherwood & Jeffery, 2000). Promoting enjoyable alternatives/activities is a strategy consistent with physical activity research amongst African-American women, in which it was suggested that interventions should emphasise the importance of choosing enjoyable physical activities (Wilcox et al., 2002).

**Weight status**

The relationship between socio-economic position and television viewing was partly mediated by women’s weight status. Consistent with a substantial body of research, it was found that women of a low socio-economic position were more likely to be overweight or obese than women of a high socio-economic position (Ball & Crawford, 2005; McLaren, 2007). Reasons for this association may
include the nutritionally poorer diets (Ball et al., 2004; Irala-Estevez et al., 2000), lower physical activity (Britton et al., 2000; Crespo et al., 1999), or greater time in sedentary behaviour (King et al., 2010; Stamatakis et al., 2009) observed amongst adults of a low socio-economic position. These inequalities highlight the importance of intervening in such a high-risk target group.

As discussed in Chapter 3, a large amount of evidence has suggested a positive relationship between being overweight and television viewing in adults (Cameron et al., 2003; Cleland et al., 2008b; Sugiyama et al., 2008b). Considering body dissatisfaction (Williams et al., 1999), poor diet/increased energy intake (Cleland et al., 2008b; Jeffery & French, 1998), and physical inactivity (Sanchez et al., 2008; Sugiyama et al., 2008a) have all been found to be associated with greater levels of television viewing, it is evident that there may be a number of underlying mechanisms that could potentially explain the mediating role that weight status plays in the relationship between socio-economic status and television viewing. However, it should be acknowledged that, as with all associations observed in this study, the direction of effects could go both ways. For example, higher levels of television viewing may lead to weight gain/higher BMI, or those with a higher BMI may consequently watch more television (perhaps because they are self-conscious about their weight or otherwise uncomfortable about being physically active). Therefore further research is needed to elucidate the mechanisms that may explain this relationship. Potentially, interventions aimed at reducing the socio-economic inequalities in television viewing could to focus on weight-loss and weight-management.
approaches such as improving diet/healthy eating, overcoming body image concerns, as well as increasing physical activity amongst socio-economically disadvantaged women. Potential strategies that may be effective within this approach may include providing disadvantaged women with educational information on healthy eating and physical activity in conjunction with providing social support for weight loss, or offering counselling concerning overcoming barriers to healthy lifestyles.

Social mediators of socio-economic inequalities in television viewing

Social cohesion

The current study found that the relationship between women’s socio-economic position (education) and television viewing was partly mediated by social cohesion. These findings are consistent with those of previous research that suggests that socioeconomic position is positively associated with social cohesion (Cohen, Farley, & Mason, 2003; Coleman, 1988). This is not unexpected given that women of a low socio-economic position (i.e. education) may be more likely to live in disadvantaged neighbourhood, which may be characterised by higher levels of crime, lower levels of neighbourhood trust and cohesion (Franzini et al., 2005; Ross, 2000).

This study demonstrated an inverse association between social cohesion and television viewing, consistent with previous findings (Beaudoin & Thorson, 2004; Hooghe, 2002; Shah, 1998), indicating that living in a more socially cohesive
neighbourhood may result in spending less time watching television. Although previous studies assessing this relationship have been cross-sectional, most authors have suggested the reverse causation; that is, television viewing has a detrimental effect on social cohesion in society (Beaudoin & Thorson, 2004; Shah, 1998). This notion follows the “mean world” hypothesis (Hooghe, 2002), whereby television programs (in particular violent programs) produce feelings of insecurity and cause mistrust in society (Gerbner, Gross, & Morgan, 1986; Putnam, 1995).

In contrast to the “mean world” implications, one other study has suggested that television viewing does not have a causal effect on social cohesion, but rather that social cohesion affects time spent watching television (Hooghe, 2002). In that study, it was found that time spent watching soap opera television programs was inversely associated with social cohesion, however time spent watching other genres (e.g. news, movies) had no association with social cohesion. Considering the “mean world” hypothesis, it would have been expected that watching programs eliciting depictions of violence (i.e. the news or violent movies) would be more strongly associated with lower levels of social cohesion than soap operas. Thus, it is plausible that people living in a neighbourhood that is not socially cohesive (i.e. low levels of trust between neighbours, sharing different values) prefer to stay home and watch television (particularly soap operas).

Given that women of a low education may be more likely to live in neighbourhoods of low socio-economic position (e.g. with higher levels of crime,
lower levels of neighbourhood trust and social cohesion), strategies to increase social cohesion within disadvantaged neighbourhoods are needed. Implementing walking groups, social support groups as well as other social activities that promote a cohesive neighbourhood may be important strategies to increase social cohesion and thus potentially reduce television viewing amongst socio-economically disadvantaged women.

**Social support from friends**

The current study found that social support for physical activity that was provided by friends partly mediated the relationship between socio-economic position and women’s television viewing. Consistent with previous physical activity research (Brown et al., 2001b), women’s socio-economic position was positively associated with friends social support for physical activity (i.e. having a friend to be active with), suggesting that women of a high socio-economic position have greater social support from friends for physical activity. One possible explanation for this is that women of a high socio-economic position may be more likely to be employed in professional occupations which offer a wider social network in which women can draw on for social support (Brown et al., 2001b). Alternatively, since women of a low education are more likely to live in disadvantaged neighbourhoods, the socio-economic differences in social support may be explained by the social characteristics of the neighbourhoods in which women reside. It could be speculated that disadvantaged neighbourhoods provide fewer opportunities for social physical activities and therefore those women perceive less social support for physical activity. Additionally, it may be that women
living in socio-economically disadvantaged neighbourhoods are likely to be socialising with physically inactive women, and hence unlikely to be able to draw support for physical activity from within their own social network.

Considering that a lack of social support is a commonly reported barrier to physical activity amongst women of a low socio-economic position (Brown et al., 2001b; Osuji et al., 2006), the findings of the current study highlight the need for promoting greater social support amongst these high-risk women, to not only increase physical activity, but also to reduce sedentary behaviours such as television viewing.

The finding that greater social support for physical activity was inversely associated with television viewing may suggest that participating in physical activity with a friend may displace time spent watching television. Previous studies amongst women have indicated that television viewing often replaces physical activity (Hu et al., 2003; Tucker & Bagwell, 1991), which may partly explain the association between television viewing and some health outcomes such as obesity (Tucker & Bagwell, 1991). Conversely, the finding that greater social support for physical activity was inversely associated with television viewing may be explained by the fact that women who perceive greater social support for physical activity may also have greater social support in other aspects of life (e.g. the arts, religious groups), which may also act to displace time spent watching television. However, the finding that social participation was not a significant mediator of socio-economic inequalities in television viewing in this
study appears inconsistent with this hypothesis. Alternatively, it may be that women who spend greater time watching television perceive less social support due to the social withdrawal effect that has been suggested to be caused by prolonged television viewing (Kraut et al., 1998; Putnam, 1995).

Only one previous study has examined the social determinants of television viewing (Williams et al., 1999). Although that cross-sectional study showed a trend in the expected direction, it found no association between social support for physical activity and television viewing amongst men or women. However, that study included a sample of university students from one geographic area, hence findings may not be generalised to the wider population. Therefore, this highlights the need for further research using more specific measures assessing social support for reducing television viewing in particular. Based on the findings of the current study, future interventions may need to focus on promoting social support for physical activity to reduce television viewing and increase physical activity amongst socio-economically disadvantaged women.

Finally, the current study found that the relationship between women’s socio-economic position and television viewing was not mediated by any perceived physical environmental factors. This finding suggests that other factors outside of the physical environment may be more important, and that interventions aimed at reducing the socio-economic inequalities in television viewing amongst women may need to focus on intra-personal and social influences. However, since women’s perceptions of the physical environment do not always match well to
objective indices of the actual physical environment (Ball et al., 2008), further studies using objective environmental measures such as Geographic Information System (GIS) technologies and/or environmental audits are required.

### 6.5.1. Limitations

Several limitations of the current study should be acknowledged when interpreting results. Firstly, the current study was of a cross-sectional design, which does not allow for causality or the direction of relationships to be determined. For example, it is not known whether having social support from friends acts to reduce television viewing, or whether those who engage in greater levels of television viewing consequently perceive having less social support from friends. However, since little research has investigated the role of intra-personal, social and physical environmental factors in mediating socio-economic gradient in women’s television viewing, the present cross-sectional findings provide important initial insights in this research area.

Secondly, self-report measures were used to assess sedentary behaviour (i.e. television viewing) as well as potential mediating factors. Although valid and reliable measures were used where possible, recall difficulties, error in judgment and socially desirable responses (e.g. reporting lower than actual levels of sedentary behaviour) potentially limit the results. Future studies could utilise objective measures such as accelerometers and activPALs for assessing sedentary behaviour. Furthermore, several measures included in this study were based on measures designed for physical activity research (e.g. social support from friends
and family; proximity to physical activity facilities; feeling self conscious; and self efficacy). Therefore, more specific measures designed to assess theoretically-derived sedentary behaviour mediators/influences are needed.

Finally, socio-economic position was defined using the individual-level measure, education. Although this is a measure that has been widely used to indicate socio-economic position in other epidemiologic and health-related studies amongst women (Ball et al., 2007; Cleland et al., 2008a; Matthews et al., 1989), a number of participants classified as having low education may not have been considered to be socio-economically disadvantaged based on other indicators such as income or occupation measures. However, education is a useful measure of socio-economic position amongst women, as it remains relatively stable during adult life in contrast to income and occupation, which fluctuate particularly during childbearing years (Mishra et al., 2001). Furthermore, education is a less ‘sensitive’ and better answered question than income (Mishra et al., 2001), and is relevant to everyone regardless of age or work circumstances (Galobardes et al., 2006a).

6.5.2. Strengths

This is the first study to examine the role of intra-personal, social and physical environmental factors in explaining the socio-economic differences in sedentary behaviour (i.e. television viewing) amongst women. The consideration of multiple intra-personal, social and physical environmental mediators, which encompassed the constructs of the social ecological model (Sallis & Owen, 1999), is an
additional strength. Since literature on the influences on sedentary behaviour amongst adult women is particularly scarce, the findings from the current study provide novel information which, if confirmed in future studies, may be used to inform intervention strategies to reduce socio-economic inequalities in sedentary behaviour amongst women. Moreover, a further strength of this study is that it included a large sample of women from neighbourhoods of varying levels of socio-economic disadvantage and therefore provided adequate power to detect associations, even after controlling for clustering by neighbourhood as well as other important covariates (marital status and children).

6.5.3. Future research and implications

Acknowledging study limitations and the need for confirmation of findings in future studies, this study suggests that focusing on providing enjoyable relaxation alternatives to television viewing, weight-loss and weight-management information, increasing social cohesion in the neighbourhood as well as friend support for activity amongst disadvantaged women may be important in reducing the socio-economic inequalities in sedentary behaviour (i.e. television viewing). However, further studies are required to understand the reasons that may explain these differences. For example, an understanding of why women of a low socio-economic position enjoy television viewing more, or why they perceive lower levels of social cohesion and friend support, than women of a higher socio-economic position will help inform the development of strategies targeted at relevant constructs in order to reduce the socio-economic gradient in women’s sedentary behaviour.
Television viewing has been linked to an increased risk of several chronic health conditions including type 2 diabetes (Dunstan et al., 2007), obesity (Cameron et al., 2003), cardiovascular disease (Kronenberg et al., 2000), and depression (Sidney et al., 1996). Despite this, it is the most common leisure-time activity amongst Australian adults (Australian Bureau of Statistics, 1998), and is particularly prevalent amongst socio-economically disadvantaged adults (King et al., 2010; Stamatakis et al., 2009). Since the socio-economic differences in television viewing parallel socio-economic gradients in many health outcomes, it is important that research focuses on understanding the factors may explain the inverse relationship between socio-economic position and television viewing. Thus, the current study provided novel findings that could inform future intervention strategies to reduce socio-economic inequalities in women’s television viewing. In the following chapter, the feasibility of intervention studies aimed at increasing physical activity and reducing sedentary behaviour amongst women experience socio-economic disadvantage are explored.
CHAPTER 7: The perceived feasibility of intervention strategies to increase physical activity and reduce sedentary behaviour amongst women living in socio-economically disadvantaged neighbourhoods

7.1. Introduction

Participating in physical activity (Teychenne, Ball, & Salmon, 2008b) and engaging in lower levels of sedentary behaviour (Sanchez-Villegas et al., 2008; Sanchez et al., 2008) have been found to be associated with a lower risk of depression. Several population groups have been found to be at a greater risk of depression, including women (Wilhelm et al., 2003) and adults of low socio-economic position (Lorant et al., 2003). These population groups are also at increased risk of physical inactivity (Armstrong, Bauman, & Davies, 2000; Bensenor, Rexrode, & Manson, 1999) and therefore comprise important target groups for research examining intervention strategies to increase physical activity and potentially reduce the risk of depression.

As identified in the review of the literature (Chapters 2 and 3), a number of previous intervention studies have been designed to reduce the risk of depression amongst women through prescribing physical activity programs. Many of those interventions incorporated strategies such as providing educational information regarding the mood-enhancing effects of physical activity (Brown et al., 2001a; Craft et al., 2007), and providing tips on overcoming barriers to physical activity as well as ways to accumulate physical activity throughout the day (Anderson et
al., 1999; Brown et al., 2001a). Furthermore, a number of studies included self-monitoring strategies such as keeping logs or records of daily physical activity (Asbury, Chandruangphen, & Collins, 2006; Brown et al., 2001a; Nabkasorn et al., 2005), or providing participants with an exercise calendar and goal-setting information (Craft et al., 2007). Although those interventions were generally effective and compliance rates were generally high for most of those studies, intervention strategies in those studies were used in conjunction with prescribing closely monitored exercise programs, which are generally time-consuming, intensive and may be expensive when implemented in a ‘real world’ setting.

Little research has assessed the effectiveness of physical activity interventions amongst disadvantaged women (Yancey, Ory, & Davis, 2006). Further, a review of physical activity interventions identified that of the existing evidence in this target group, most studies have focussed on women in the U.S from racial/ethnic minority backgrounds (Marcus et al., 2006). One study assessed the effect of two physical activity interventions amongst a multi-ethnic sample of low-income women (Albright et al., 2005). Participants were randomised into one of two groups: either a mail support intervention group, in which participants received print information about local physical activity events and organisations, seasonal tips for maintaining physical activity, health education as well as a pedometer; or a telephone-based counselling intervention group, in which participants received feedback and support for physical activity through regular telephone counselling as well as the print materials that the mail support group received. That study found that both groups increased their physical activity levels initially, yet this
was only maintained in the telephone-based counselling intervention group. A major limitation of that study, however, was that no “no-treatment” control group was included. Furthermore, a high proportion of women in the study were of Mexican-American or Latina ethnicity (~70%) and therefore results may not be generalisable to low income women of other backgrounds or in other countries such as Australia.

There has been increasing interest in recent years in web-based physical activity interventions (Norman et al., 2007). For example, one study assessed the effectiveness of an interactive physical activity website and e-mail intervention for increasing physical activity amongst women (Dunton & Robertson, 2008). The website provided personalised feedback based on women’s physical activity level and behavioural stage of change, as well as advice on how to overcome barriers to being active, whilst emails included goal-setting information and advice on how to keep a physical activity journal. Consistent with findings from other web-based physical activity interventions amongst women (Dinger, Heesch, & McClary, 2005), that intervention was successful in increasing women’s walking and moderate-intensity physical activity. To date, no web-based physical activity interventions have been designed specifically for, and assessed amongst socio-economically disadvantaged women.

Most previous physical activity interventions amongst adults have adopted individual-level approaches (Marcus et al., 2006). However, increasing evidence, consistent with the social ecological model (Sallis & Owen, 1999), attests to the
importance of factors within the neighbourhood environment for influencing physical activity (Trost et al., 2002). Although several environmental interventions have been conducted within the general population (Matson-Koffman et al., 2005; Sallis, Bauman, & Pratt, 1998), few studies have tested these strategies amongst socio-economically disadvantaged women.

As discussed in Chapter 3, very few intervention strategies aimed at reducing sedentary behaviour in adults, let alone socio-economically disadvantaged or depressed women, have been assessed (Foster, Gore, & West, 2006). Of the small number of intervention studies that have aimed to reduce sedentary behaviour amongst adults, a large proportion included strategies that were predominantly focused on changing physical activity behaviour. For example, one community controlled trial assessed the ‘unintended’ effects of a pedometer-based physical activity intervention study on adults sitting time (De Cocker et al., 2008). That intervention was based on the social ecological model by providing pedometers to participants as well as physical activity information via a local media campaign within workplace settings and the neighbourhood environment (i.e. street signs). Results showed that the pedometer-based physical activity intervention was effective in reducing sitting time in adults. One other randomised controlled trial aimed at reducing sedentary behaviour amongst adults (Otten et al., 2009) utilised an electronic monitor which shut off the televisions of intervention participants when they reached their weekly viewing limit (which was equivalent to half of their objectively measured television viewing time at baseline). That study was effective in reducing television viewing time, with
further intervention effects shown to reduce BMI and increasing energy expenditure. However, further studies are needed to understand the most effective intervention strategies for reducing sedentary behaviour amongst adults, in particular socio-economically disadvantaged women.

The findings from the qualitative study reported in Chapter 5 showed that women living in socio-economically disadvantaged areas and experiencing depressive symptoms identified several potential strategies that they felt would help increase their levels of physical activity and reduce sedentary behaviour. Strategies suggested covered intra-personal, social and physical-environmental components of the social-ecological framework (Sallis & Owen, 1999) and included: public awareness campaigns (to increase knowledge of the physical and mental health benefits of physical activity); learning time management and multi-tasking skills; more childcare facilities (e.g. more one-hour care facilities); engaging family and friend support; new mother’s exercise groups; provision of information on available facilities in the neighbourhood; more variety of classes/facilities or longer opening hours of facilities; women’s only gyms/exercise classes; and more social recreational exercise and support groups. Standing rather than sitting (when watching television or at the computer) was also suggested as a behavioural strategy to help decrease time spent in sedentary behaviour.

Although previous studies have examined the perceived feasibility of intervention studies aimed at increasing physical activity amongst socio-economically disadvantaged women (regardless of depression status) (Opdenacker et al., 2008;
Watson et al., 2005, to the candidate’s knowledge, no previous studies have tested the perceived feasibility and effectiveness of intervention strategies aimed at increasing physical activity and specifically reducing sedentary behaviour amongst women with and without depressive symptoms and living in socio-economically disadvantaged areas. The findings from the qualitative study reported in Chapter 5, as well as those from previous research on physical activity interventions aimed at reducing the risk of depression amongst women, founded the ideas for the development of the print-based and web-based intervention materials used in the current study. Both intervention formats (print-based and web-based) were developed with the aim of helping women overcome the intra-personal, social and environmental barriers to increasing physical activity and reducing sedentary behaviour, identified in previous research amongst women at risk of depression and living in socio-economically disadvantaged areas (see Chapter 5).

Several population groups are typically ‘hard to reach’ in research studies and health promotion programs. These groups include socio-economically disadvantaged adults (Freimuth & Mettger, 1990; Madigan et al., 2000) and individuals experiencing depression (Clark et al., 1983; Williams & Macdonald, 1986). Therefore, due to logistical and ethical difficulties anticipated in attempting to purposefully recruit socio-economically disadvantaged women with depression, the current study focussed on all women living in a socio-economically disadvantaged neighbourhood (which included a small sub-sample of women with depressive symptoms), considering they are a population group
both at risk of depression (Lorant et al., 2003; Wilhelm et al., 2003) and of physical inactivity (Armstrong, Bauman, & Davies, 2000; Bensenor, Rexrode, & Manson, 1999).

Given the key role that community stakeholders play in promoting and/or facilitating health-related interventions (Ballew et al., 2010), it was considered important to also explore their perceptions and insights regarding the feasibility of strategies to increase physical activity and reduce sedentary behaviour. It was felt that stakeholders involved in physical activity/health promotion in local communities could potentially provide researchers with rich insights into applying these strategies in real-world settings. Therefore this study also recruited a small sub-sample of key stakeholders from organisations representing public policy, health promotion, community health and well-being.

7.2. Aims

The current study aimed to investigate the perceived feasibility of two proposed intervention approaches (one print-based and one web-based) designed to promote physical activity and reduce sedentary behaviour amongst women with and without depressive symptoms and living in socio-economically disadvantaged areas. Furthermore, the study aimed to investigate the feasibility of the two proposed intervention strategies amongst a small sample of key stakeholders.
7.3. Methods

Since qualitative methods are useful for investigating areas in which little is known, the qualitative design of this study (see Appendix 14) was chosen in order to provide rich insights for the development of strategies to promote physical activity, reduce sedentary behaviour and in turn reduce the risk of depression amongst women living in socio-economically disadvantaged areas. The methods and procedures are described below.

7.3.1. Participants

Participants in the current study were randomly recruited from one urban Victorian neighbourhood of low socio-economic position (SEP). The measure of SEP was based on the Australian Bureau of Statistics SEIFA - Socioeconomic Index for Areas (Australian Bureau of Statistics, 2003) (see section 4.3.1 for further details). Urban suburbs ranked in the most disadvantaged decile within Victoria, with a population of 5000 people or more and (for logistical reasons) located within a 100km radius of Melbourne were included in the selection pool, and one suburb was randomly selected from this pool. Address and suburb data for the whole of Victoria was obtained using the spatial data files VicMap Address and VicMap Admin (both owned and supplied by State of Victoria). Residential addresses within the selected suburb were identified and extracted using a Geographic Information System (GIS) software (ESRI: ArcGIS 9.2. Redlands, CA 2007). The database enclosing all residential addresses for the selected suburb was used to randomly select 850 households.
Surveys were mailed out to those 850 households and women living in a selected household and aged 18 or over were invited to participate. Where there was more than one eligible woman living in a household, the woman with the next birthday was asked to participate.

Furthermore, local community/neighbourhood houses were contacted (Appendix 15) and invited to display recruitment posters for the study. Those centres who agreed were sent recruitment posters with contact information for the study to display on their noticeboards (Appendix 16 and 17). Women interested in participating were asked to contact the researcher, those who were interested were then sent a survey pack.

From the 850 surveys sent out, a total of 67 were classified as return to sender (due to insufficient address) whilst a total of 37 women (five with depressive symptoms and 32 without depressive symptoms) returned a completed survey representing a response rate of 5%. The recruitment posters in the community/neighbourhood house/centre did not result in any contacts from women.

A second group of participants, consisting of representatives from stakeholder organisations within the same neighbourhood whose roles included public policy, health promotion, or community health and well-being were also selected to participate in the current study (n=8). Of the eight key stakeholders selected and contacted, seven agreed to participate with five returning a completed survey.
7.3.2. Ethics

Ethical approval for this study was obtained from the Deakin University Human Research Ethics Committee (HEAG-H 32/2010).

7.3.3. Procedures

Households selected for the study were sent a survey pack in the mail, which included a detailed letter (Appendix 18) informing recipients that their household had been selected to take part in a study about strategies to promote women’s physical activity in the area and that women living in a selected household and aged 18 or over were invited to participate. The pack also included two pilot intervention strategies (one print-based information booklet and one web-based activity calendar with instructions, see Appendices 19-21) as well as a survey (Appendix 14). A plain language statement detailing the study and procedures was also included in the pack (Appendix 22). Respondents who returned a completed survey could indicate whether they would like to go in a draw to have the chance to win a $200 gift voucher in appreciation of their time (Appendix 23). Following the Dilman protocol (Dillman, 1978), a reminder letter was mailed out to selected households two weeks later (Appendix 24).

Additionally, key local stakeholders within the study suburb were identified from organisations (local council, health promotion organisations, and neighbourhood/community houses) that had direct involvement in promoting health and wellbeing in the community. A letter of invitation was sent to seven
key stakeholders (Appendix 25) and followed up with a telephone call two weeks later (Appendix 26). Stakeholders who agreed to participate were then sent a survey pack in the mail, including a plain language statement (Appendix 27), a stakeholder questionnaire (Appendix 28) and the two pilot intervention strategies (Appendices 19-21). A general results letter was sent to all participants two months after the conclusion of the study (Appendix 29).

7.3.4. Intervention Materials

Both interventions were developed by the PhD candidate and incorporated elements from the social ecological model (Sallis & Owen, 1999) as well as successful behaviour change strategies discussed in Chapter 3 (e.g. goal-setting, self-monitoring, social support).

Information Booklet

Since living in socio-economically disadvantaged neighbourhoods is generally associated with low education (including literacy) levels (Galobardes et al., 2006a), written materials have historically not been seen to be the most effective strategy for promoting healthy behaviour in such a target group. However, the information booklet used in the current study (see Appendix 19) was designed to require minimal reading, used simple language and included numerous pictures and graphic illustrations of ideas. The 15-page booklet was designed specifically and tailored for the selected study neighbourhood, and provided information about why it is important to be physically active and reduce sitting time, practical
ideas to increase levels of physical activity and reduce sitting time, availability of facilities to exercise in the neighbourhood (including women-only facilities, recreational clubs, places to walk your dog, exercise options for new mums, as well as safer areas to exercise), availability of childcare facilities in the specific study neighbourhood, and contact information for various support groups.

**Online Activity Calendar and Diary**

The online activity calendar and diary (see Appendix 20) was a mock website designed to allow users to log on and schedule their physical activity goals for the week, month and year. The site was designed such that the user could mark off daily when they had been physically active and/or reduced time spent sitting. At the end of the week, the computer program was designed to determine whether the user achieved their physical activity goals and it provided tailored feedback for the user based on actual physical activity levels. There was also an online forum in which it was proposed users could chat with other women and share any tips and advice they have for becoming physically active and reducing sitting time. A motivational quote was provided each day to help women achieve their goals.

**7.3.5. Measures**

The Women’s Activity Study survey, which is included in Appendix 14 (women’s version) and Appendix 28 (key stakeholders’ version), included questions which required participants to provide written feedback on their views of the potential feasibility of two proposed intervention strategies provided in the
survey pack (see Appendices 16-18). Furthermore, the survey for women (but not stakeholders) included self-report measures of socio-demographic characteristics, physical activity, sedentary behaviour and depressive symptoms.

7.3.5.1. Demographic Information (Questions E1-E8 in Appendix 14)
Socio-demographic characteristics of participating women were collected. These included: age; highest educational qualification (never attended high school; year 10 or equivalent; year 12 or equivalent; technical or trade school certificate/apprenticeship; university or tertiary qualification); employment status (working full-time; part-time; unemployed/laid off; keeping house/raising children full-time; student; retired); and marital status (married; de facto; separated/divorced; widowed; never married). Country of birth, pregnancy status, and the number and age of children living at home were also assessed.

7.3.5.2. Physical Activity (A1-A11)
Women’s leisure-time physical activity was measured for descriptive purposes only, using items from the International Physical Activity Questionnaire (IPAQ-L), a validated measure involving a seven-day recall of physical activity behaviours (Craig et al., 2003). The reliability of the IPAQ-L has been tested and is comparable to most other established self-report methods (Brown et al., 2002; Craig et al., 2003). Questions included the frequency and duration of time spent undertaking various intensities (walking, moderate and vigorous) of physical activity in leisure-time. Participants were required to estimate the number of days, hours and minutes they spent undertaking such activities in the past week. For
example, the following questions were asked; “During the last 7 days, on how many days did you do vigorous physical activities like aerobics, running, fast bicycling or fast swimming in your leisure-time?” and “How much time did you usually spend on one of those days doing vigorous physical activities in your leisure-time?” The same questions were asked for moderate-intensity physical activity and walking during leisure-time (see Appendix 14 for further details).

Physical activity variables were summed across intensities to give a total duration of leisure-time physical activity. This was done by multiplying the frequency of activities by the duration, then truncating this data to remove unrealistic out of range values. Total weekly leisure-time vigorous physical activity (0%), moderate physical activity (2.7%) and walking (8.1%) were all truncated at 14 hours. The selection of cut-points was based on previously employed approaches described in Chapter 4 (see section 4.3.4.3)

### 7.3.5.3. Sedentary Behaviour (A12-A15)

Four measures of sedentary behaviours were included in the survey for descriptive purposes only: overall time spent sitting at work, overall time spent sitting during leisure-time, time spent sitting watching television and time spent sitting at a computer. Overall sitting in the past week at work and for leisure (weekdays as well as weekends) was assessed using the International Physical Activity Questionnaire (IPAQ-L) (Craig et al., 2003). Participants were asked to estimate the number of hours and minutes spent sitting at work and during leisure-time on a weekday, as well as a weekend day.
Time spent sitting watching television and sitting using the computer were examined separately. Participants were asked to estimate the number of hours and minutes they spent undertaking those activities on a weekday, as well as a weekend day. For example, to assess computer sitting time the following questions were asked; “Of your total sitting time, during the last 7 days, how much time did you usually spend sitting at a computer on a weekday?” and “Of your total sitting time, during the last 7 days, how much time did you usually spend sitting at a computer on a weekend day?”.

Sedentary behaviour variables were summed to give a weekly duration of time spent in each sedentary behaviour. This was done by multiplying the duration of each sedentary behaviour performed on weekdays by five (days) then adding this to the weekend days total duration (duration multiplied by two [days]). Data for each sedentary behaviour variable were then truncated. Total weekly sitting time at work (2.7%), total weekly sitting during leisure-time (0%), television viewing time (0%), and computer use (0%) were all truncated at 126 hours.

7.3.5.4. Depressive symptoms/well being (B1)

Depressive symptoms were assessed for descriptive purposes only, using the 10-item version of the Centre for Epidemiologic Studies Depression Scale (CES-D). This scale includes questions that relate to various symptoms of depression that may have been experienced in the past week, which indicate whether a woman is at risk of depression. Women responded using a 4-point severity scale. Examples
include: “I was bothered by things that usually don’t bother me” [Rarely or none of the time; Some or little of the time; Occasionally or a moderate amount of the time; Most or all of the time]; “I was happy” [Rarely or none of the time; Some or little of the time; Occasionally or a moderate amount of the time; Most or all of the time]. The CES-D is a well-validated measure of depression (Andersen et al., 1994; Radloff, 1977) and has been used in previous studies examining the association between physical activity and depression (Galper et al., 2006; Stephens, 1988; Teychenne, Ball, & Salmon, 2010).

Management of depression scores

CES-D response categories for items 5 (“I felt hopeful about the future”) and 8 (“I was happy”) were reverse-coded (i.e. scored 0 for responses indicating respondents experienced this “most or all of the time”; 1 for responses indicating they experienced this “occasionally or a moderate amount of time”; 2 for responses indicating respondents experienced this “some or little of the time”; 3 for responses indicating respondents experienced this “rarely or none of the time”). For all other items (e.g. Item 3: “I felt depressed”), response categories were scored 3 for responses indicating that respondents experienced this “most or all of the time”; 2 for responses indicating respondents experienced this “occasionally or a moderate amount of time”; 1 for responses indicating respondents experienced this “some or little of the time”; 0 for responses indicating respondents experienced this “rarely or none of the time”. Responses were then summed across the 10 items to provide a total score. CES-D scores of 10 or greater indicate that the participant is at risk of depression (Andersen et al.,
Participants were then categorised into either ‘at risk of depression’ or ‘not at risk of depression’ as per established protocols (Andersen et al., 1994).

7.3.5.5. The perceived feasibility of two intervention strategies

The perceived feasibility of the two potential intervention strategies was assessed through a series of short-answer questions (Appendix 14 [women’s version] and Appendix 28 [key stakeholders’ version]). Participants were asked to read through the intervention materials and then provide feedback and/or suggestions on each strategy by completing the questionnaire. Questions included: “What do you like about the information booklet?”, “What don’t you like about the information booklet?”, “What other information do you think would be useful in motivating you to be more active?”, “What other information do you think would be useful in motivating you to sit less?”, “In what way would the information be best delivered? (e.g. monthly instalments in the mail [leaflets] or emails, all at once, a website, an i-phone application etc.)”. Finally, participants were asked “Which physical activity strategy do you think would be more likely to result in an increase in physical activity and a reduction in daily sitting time, and why? (i.e. the information booklet or the online diary and calendar?)”. Key stakeholders were asked the same questions in regards to their perspectives about what they felt would be most feasible for women in their community. Examples of such questions included “What other information do you think would be useful in motivating women to be more active?” and “What other information do you think would be useful in motivating women to sit less?”
7.3.6. Data Analysis

Demographic characteristics of participants were initially examined using descriptive analyses performed using SPSS version 14.0 statistical software. Descriptive statistics were used to characterise women's participation in leisure-time physical activity, women’s participation in sedentary behaviours, and presence of depressive symptoms.

After reviewing all short-answer responses from women and key stakeholders, the qualitative data analysis program NVivo was used to organise data and perform thematic analyses following the methods described by Green et al. (2007). The first step in data analysis, immersion in the data, consisted of reading all of the short-answer responses several times. Following this step, data were coded with descriptive labels. For example, labels for the information booklet included: ‘increased awareness of available exercise facilities’, ‘prices included’, ‘all research done for them’. These labels were concurrently categorised by linking coded data together based on similar concepts (e.g. ‘informative resource’) (Green et al., 2007). Furthermore, for those questions on ‘which approach you would prefer?’ simple counts were taken and tallied. In order to check the reliability of the interpretation of the data, researcher triangulation was employed. A random subset of 4 transcripts was cross-coded by a second and third researcher (PhD supervisors) to check for inter-coder agreement. No discrepancies in coding or interpretation were observed. Finally, key themes and concepts (e.g. ‘increasing awareness’) were then linked to direct written quotes, allowing for a thorough interpretation of the perceived feasibility of the two
potential physical activity interventions. Illustrative quotes are provided in the Results section (Section 6.4) with participant’s age and pseudonym.

7.4. Results

The final sample consisted of 37 women and five key stakeholders. Five women were classified as being at risk of depression (according to the CES-D). The mean age of participants was 50 years (aged 18-34 = 14%; aged 34-49 = 30%; aged 50-64 = 49%; aged 65 and over = 8%). Demographically, two-thirds of the sample were in a married or defacto relationship (65%) and 40% of women had children living at home. Just over half of the women were employed part-time or full-time with just under one-quarter of women retired (22%). About 10% reported a low level of education (had not completed secondary education), 38% a medium level (completed year 12 and/or vocational training), and half had a university degree (51%). All five key stakeholders were women who worked in managerial roles representing local government, a neighbourhood/community house, a local gym, a specialised personal training business, and a community health centre.

Of the physical activity undertaken in leisure-time, women spent more time walking (mean = 2.75 hrs/wk) than in other moderate-intensity (mean = 57 mins/wk) or vigorous-intensity (mean = 48 mins/wk) physical activity. Participants reported just under 10 hours per week (approximately 1.4hr/day) sitting at a computer and approximately 23 hours per week (3.3hr/day) sitting watching television. On average, women reported 31 hours per week sitting...
during leisure-time (approximately 4.5hr/day) and 15 hours per week (approximately 2hr/day) sitting at work.

In regards to the qualitative data which were based on women’s opinions and thoughts about the perceived feasibility of the two potential intervention strategies (i.e. information booklet and online physical activity calendar), several key themes were revealed.

**Information Booklet: What women liked**

On balance, most women were impressed with the booklet and suggested that it was something that they would certainly be using for future reference.

“I think it is quite excellent and will use it” (Orla, 62)

“Can I please be subscribed to it!” (Erin, 21)

Additionally, one key stakeholder mentioned that the information booklet was a resource that they could use for female clients.

“I use the physical activity directory for older people on a regular basis with my adult clients. I have had a student start to draw up a similar directory for children under school age [but there is] not much out there! And yours will be great for women’s health clients (pregnant and post-natal women) – again not much out there in Neighbourhood X specifically for them” (Key Stakeholder)
Informative

Nearly every woman mentioned that they liked the level of detailed information included in the booklet. However, the type of information seen as most important varied for women. Some mentioned liking the inclusion of prices, times and contact information for clubs and facilities, while others mentioned that they liked that it exposed them to a variety of activities that they were unaware of.

“It is very informative, offers a lot of options. I like that it includes prices and all necessary information” (Erin, 21)

“It is a comprehensive booklet giving advice on ways to keep fit as well as giving details of lots of activities to get involved in” (Wilma, 63)

It was apparent that women appreciated that all the information was sourced for them, saving them time and effort when preparing to be physically active.

“I think it is a great way to see everything that is out there for women of all ages and abilities without having to do the searching” (Fiona, 56)

“Excellent reference for what is available in Neighbourhood X. Great tips to increase physical activity without necessarily spending more time” (Adelle, 58)

Local relevance

It was evident that women living in the selected neighbourhood felt that they had previously received little attention in regards to being provided local health and physical activity information. Several women mentioned appreciating how locally-relevant the information in the booklet was.

“Thank-you for doing something for the Neighbourhood X area” (Pearl, 57)
“Having just moved to Neighbourhood X I loved the book. I just didn’t realise there was that much to do” (Katrina, 56)

Most women mentioned that the information on local walking tracks was particularly useful, whilst just over half the women mentioned that the information on local social physical activities was relevant to their needs.

“It gives [me information on] other places I can go walking in my free time” (Delia, 41)

“[I like] that there is great activities out there for women as we had these facilities to keep us active and socialise with the community” (Fran, 52)

**Specific to all women’s needs**

Several women suggested that the information booklet met all women’s needs by providing health and exercise information relevant to younger women, older women, pregnant women as well as new mums.

“*Positive information for a range of women’s needs*” (Bannie, 55)

“*Previous information has not specifically targeted women’s health and fitness – just general local info. Here it is all in a nutshell*” (Orla, 62)

However, a handful of women disagreed, suggesting that the booklet lacked information for older women;

“*Would like to see more input (if any available) for my age group – Seniors… For single seniors [or] social activities for example…”* (Gertrude, 62)
Presentation

Over half the women mentioned that the booklet was comprehensive and well presented, particularly remarking about the colours and photos included. This was further highlighted by several key stakeholders.

“I like the pictures and inclusion of colour, not too detailed, but enough info to locate the various activities” (Bannie, 55)

“The booklet was well laid out and very easy to read” (Irene, 54)

Several women suggested that the map at the end of the booklet (which included the locations of all facilities and clubs) was most useful and this belief was reiterated by a few key stakeholders.

“It spells out clearly what and where one can go with a very helpful map in the back for those of us new to the area” (Verity, 64)

“The ‘places of interest’ map and legend on the back page was a highlight” (Key Stakeholder)

New ideas to increase physical activity and reduce sedentary behaviour

It was apparent that a number of women appreciated the way that the information booklet was able to provide ideas on how to fit physical activity into busy women’s lives.

“Nice suggestions for “life organisation” to fit exercise in to “time-poor” women” (Ingrid, 55)

“The booklet provides down to earth advice with an understanding of the situations women find themselves in today. i.e. young mums with a home to run, children to care for, work outside the home, and older ladies” (Verity, 64)
Similarly, a couple of women mentioned that the tips to reduce sedentary behaviour were useful and that they would start implementing some of these strategies.

“Like the idea of standing at the computer” (Nicole, 30)

“When using the computer I will set a timer, so I remember to get up, get away, stretch, breathe some fresh air” (Orla, 62)

In contrast, one key stakeholder suggested that the tips to reduce sedentary behaviour were impractical and unrealistic, particularly for those using computers for work-related purposes.

“Page 4 is good information but unrealistic, especially the stand up while on computer. When I worked in finance I sat at a desk all day I would have scoffed at that suggestion” (Key Stakeholder)

**Information booklet – What women did not like**

Despite the fact that over one-quarter of the women mentioned that there was nothing about the booklet that they did not like, there were aspects of the booklet that some women suggested needed to change.

**Lack of personal tailoring**

A number of women suggested that the information booklet lacked information relevant to their personal needs and lifestyles. For example, several women mentioned that the times of exercise classes that were referred to in the
information booklet did not fit in with their weekly schedule due to work or family commitments.

“Many of the activities are during my working hours and therefore I’m not likely to be able to make it” (Nicole, 30)

Similarly, a few older women suggested that the booklet needed to include more information on exercise options that were relevant to their age-group

“Not much for the over 50’s” (Trish, 52)

“Perhaps “age-specific” activities, clubs, groups would be more interest to me, as I am 57 years old and have some illnesses to contend with at present” (Pearl, 57)

**No new information**

A handful of women believed that the booklet did not provide them with any new information, but suggested that it may be helpful to those new to the area.

“...the book is quite informative but I am aware of the services and activities provided because I have lived here for a number of years” (Courtney, 43)

“...it may be more useful to someone who doesn’t know about these places” (Sarah, 42)

**Unrealistic tips**

Several women thought that the booklet provided unrealistic tips on increasing physical activity and reducing sedentary behaviour. This view was further highlighted by a key stakeholder.

“Having seen the number of overweight women in Neighbourhood X, it
may be a tall order for many to consider getting up 30 minutes earlier, a more realistic suggestion may be 15 minutes” (Edith, 67)

“Office/admin work necessitates a fair amount of sitting regardless” (Hannah, 45)

Other useful information to increase motivation for physical activity

A number of suggestions were proposed by women that may help to motivate them to be more physically active. These included being provided information tailored to the individual (i.e. age-group relevant exercise classes/groups) as well as other suggestions not previously mentioned.

Weight loss information

It was apparent that women were particularly interested in physical activity for the purpose of losing weight. Therefore, several young women suggested incorporating other weight-related information (e.g. nutrition) into the booklet which may help women with weight management.

“Being told [that] if I did something extra, I’d lose so many kg’s” (Bridie, 36)

“Can add healthy eating/seasonal recipe ideas” (Nicole, 30)

“Nutrition information and motivation tips” (Lana, 19)

Similarly, this kind of approach (providing weight loss information) was suggested by one key stakeholder in order to reduce sedentary behaviour.

“People like info i.e. If you get up and change the channel rather than use the remote you can burn 20 calories each time. Weight loss always motivates women” (Key Stakeholder)


**Seasonal Suggestions**

One woman mentioned that she would like to see more tips/suggestions in the booklet about exercises that you can do in winter in order to overcome such barriers.

“*More winter exercise ideas – it’s dark when I get home after work and very cold currently*” (Nicole, 30)

Conversely, one other woman believed that there was enough information in the booklet to overcome the barrier of poor weather in order to be physically active.

“*…The wet weather has hampered my activities. There is ample info in the booklet to motivate activity in other ways*” (Natalie, 48)

**Vouchers**

One key stakeholder suggested that to overcome the barrier of cost, and perhaps increase motivation to begin exercising, it may be useful to include discount vouchers in the booklet to the facilities or clubs within in the community e.g. gym discount. Although, no other women made the same suggestion.

“I think you have provided all possible info but maybe including some vouchers from the companies you have put into the booklet”
(Key Stakeholder)

**Other useful information that may help to reduce sedentary behaviour**

About a quarter of the women believed that they did not sit very often, and therefore not surprisingly, few women were able to suggest ideas on other information that may help them reduce their sedentary behaviour (sitting time). Suggestions offered were for further information that was already included in the
booklet (i.e. health risks of sitting, and tips to reduce sitting).

**Lifestyle tips to reduce sitting**

Being provided with more tips and ideas on how to reduce sitting time in daily lives was suggested by a few women as a means of reducing their own sedentary behaviour.

“More ideas on how to do things standing up” (Bannie, 55)

“ideas regarding walking to printer each time you print etc. Small breaks while sitting” (Nicole, 30)

**Health risks of sitting**

A couple of women mentioned that providing more information on the health consequences of sitting may motivate them to sit less, which was also suggested by a key stakeholder.

“Maybe more [information on] medical problems/issues arising from sitting too much” (Rachel, 45)

**How the information booklet may help increase physical activity**

Most women could identify ways in which the information booklet would help increase their physical activity, with nearly all of them suggesting that the provision of information on physical activity groups/classes and walking tracks would be of most benefit.

**Increasing awareness of available physical activity groups and walking tracks**

Several women mentioned that by providing information on social physical
activity classes/groups it would help them become more physically active, with a couple of women suggesting that the booklet had already inspired them to join a class.

“Information on certain activities, groups, outings would help me to be motivated – I like “a chat”, so company in doing things is vital” (Pearl, 57)

“It did inspire me to keep going with my current sports and I queried adding a new class/activity to my exercise list” (Nicole, 30)

“I am joining yoga classes now – like tomorrow!” (Orla, 62)

Similarly, it was suggested by several women that the information on walking tracks in the area was beneficial for increasing their physical activity as it provided them with new ideas on where to walk for their own exercise, as well as their dog.

“Discovered more walking tracks to try out” (Hilary, 44)

“I may try other parks to walk dog and join some group(s)” (Rachel, 45)

Motivation

Several women mentioned how the booklet would be a source for motivation and encouragement, with one woman suggesting that it was ‘a reminder’ to be active. This motivation for activity was also mentioned by key stakeholders.

“This book is very motivating” (Fran, 52)

“Just a reminder to be more active” (Gretel, 48)

“Inspire them/motivate them with reasons to be active” (Key Stakeholder)
How the information booklet may help to reduce sedentary behaviour

Although five women suggested that the information booklet would not help reduce sitting time, most women could identify aspects of the booklet that would help.

“[it won’t help] much – besides nightly TV viewing, most of my other sitting is unfortunately unavoidable” (Rachel, 45)

“Nature of work and some leisure means I have to sit” (Hannah, 45)

Tips and suggestions to try

Nearly half the women felt that the tips and ideas to reduce sitting time that were provided in the information booklet would help them spend less time in sedentary behaviour. The ideas of standing at the computer, as well as doing exercises in front of the television were mentioned by several women as ideas that they will be trying.

“More exercise ideas to do in my lounge room where my baby is sleeping” (Cath, 31)

“I’ve been considering the issue of TV watching and have been trying to think of some things to do. I do some leg exercises at the moment. More ideas needed” (Bannie, 55)

“Started me thinking about reducing sitting time at work” (Nicole, 30)

Increasing awareness of walking tracks

A few women mentioned that the information booklet would help them reduce sitting time by increasing their awareness of the places to walk in their area, thus displacing the time spent leisure-time engaged in sedentary behaviour with time spent walking.
“By showing the safe places to walk during the day” (Katrina, 56)

Information booklet – Best delivery method

More than half the women felt that the information booklet would be best delivered through monthly leaflets in the mail.

“Mail newsletter! Not everyone (including me) has easy access to e-mail or internet, or doesn’t have an I-phone. All at once would be too much info but monthly would be good” (Erin, 21)

However, a few women suggested that the most appropriate way of delivering the material in the mail would be all at once to be used as a reference book, with one woman suggesting leaflets would only be thrown away.

“Probably as a reference booklet to keep near the telephone and a point of reference for others in need” (Edith, 67)

“…leaflets [are] easily thrown in the recycling bin” (Courtney, 43)

Alternatively, just over a quarter of women suggested that the information would be best delivered through a website or e-mail program, with a handful of women suggesting an i-phone application would be of value.

“For me, a website. I get a lot of inspiration now from diet websites and forums, although I don’t join in the conversations, the courageous efforts and solutions people have are a big help” (Verity, 64)

“Via e-mail or i-phone application – better environmentally” (Jacqui, 36)

“A website – with occasional info via e-mail to registered users to re-boot interest and provide new ideas” (Bannie, 55)

A combination of mail, online technology (website or e-mail) as well as phone
technology was suggested by a few women in order to distribute the information by tailoring the approach to the needs and lifestyles of all women. This was reinforced by the views of key stakeholders.

“i-phone app. The younger or more technologically advanced would benefit. Mail leaflets. The older people or people with no internet will benefit” (Lana, 19)

“All of the above – Take into account lower incomes (need leaflets), older adults (no computer), modern mums (X Gen. I-phone)” (Key Stakeholder)

Online calendar: What women liked

Although there were numerous aspects of the online activity calendar that women mentioned being impressed by (motivational quote, online forum, presentation, tailoring to the individual), four major themes were evident.

Presentation/Easy to use

Most women mentioned that the online activity calendar was well presented and particularly enjoyed the bright colours and simplicity of the layout.

“I like the attractive layout (cheery)” (Verity, 64)

“Looks easy to complete, colourful, encouraging” (Bannie, 55)

Moreover, women suggested that the program was easy to understand and user-friendly, which appeared to be an important factor for key stakeholders also.

“Well thought through. Easy to read. Easy to operate. Good layout” (Hilary, 44)

“Easy to read. Good for helping to motivate. Looks easy to navigate” (Jacqui, 36)
“Clear and simple” (Key Stakeholder)

**Self monitoring/planning**

A large proportion of women and key stakeholders mentioned that the online activity calendar was a good way to plan and track physical activity goals, with some women suggesting it would work as a ‘reminder’ to exercise.

“*Would make sure I don’t forget to exercise*” (Cath, 31)

“A great way to plan and execute, as well as monitor your progress”
(Pearl, 57)

“It allows people to plan their activities and cross them off as they do them” (Key Stakeholder)

Although it was apparent that women who liked scheduling time were impressed by this aspect of the calendar, one woman suggested she would not use it since she didn’t like to live to a schedule.

“I’m a schedule-loving soul so right up my alley” (Verity, 64)

“It’s a good idea for someone who likes to schedule time like that but I don’t so I most likely would not use it” (Courtney, 43)

**Motivational**

A number of women believed the online activity calendar could be used as a motivational tool, particularly by those who may be extrinsically motivated. They mentioned how it was encouraging and somewhat rewarding. This view was replicated by key stakeholders.

“*An incentive to reach your goals. A reward when you do*” (Adelle, 58)

“For those that require an external encouragement to exercise (i.e. people pleasing) it’s fine” (Hannah, 45)

“It’s a great motivational tool” (Key Stakeholder)
**Tailored to the individual**

A couple of women also suggested that they liked how the online activity calendar was personalised and tailored to individuals, which was reinforced by a key stakeholder.

“Very personalised. Lots of positive reinforcement” (Key Stakeholder)

**Online calendar: What women did not like**

Although only seven women said that they would not use the online activity calendar, most women suggested that there were aspects of the calendar that they did not like.

**Time-consuming**

Many women believed that the activity calendar would be energy- and time-consuming, with most women suggesting that they already lacked time in their lives and therefore logging on to this program may be seen as a chore.

“A bit out-of-touch with women’s lives. Who has time to do this stuff?” (Ingrid, 55)

“That it’s another chore to add to already too many I have” (Rachel, 45)

“Looks like a whole lot of time and energy” (Nicole, 30)

Similarly, a few women mentioned that the fact that it was online was a reason why they were not interested in this strategy, which may be due to the extra perceived effort of logging on to track physical activity goals.

“That it is online – difficult to access the internet to update it” (Erin, 21)
Goal non-achievement

A few women mentioned their concern about how they would feel if they did not achieve their physical activity goals for the week, suggesting that the online activity calendar may have negative effects on their motivation and achievement.

“May be too overwhelming. Shows where goals were not met – “I’m a failure” type thinking” (Trish, 52)

“If you don’t reach goals at end of week could be depressing – Think people would tire of doing this every week” (Fiona, 56)

Similarly, one key stakeholder held the same concern, suggesting the need for social support to develop problem solving skills in order to overcome this motivational barrier to physical activity.

“I wonder if they would give up if they didn’t achieve their goals and didn’t have a group to help them problem-solve or for support…but perhaps that’s one of the roles of the forum” (Key Stakeholder)

Condescending tone

Several women felt that the online activity calendar was condescending; in particular the feedback provided when one achieves or does not achieve their weekly goals. A couple of women suggested that the ‘emoticons’ that provide the feedback were “annoying” and believed that self-motivated women may actually resent the program.

“A bit condescending I think. Common sense – shouldn’t need to log-on etc to get motivated” (Ingrid, 55)

“Not sure about the comments in the ‘Goal achieved’ section…Having a smiley face tell me to try an extra session next week pushed the limit a bit…” (Hilary, 44)
How the online calendar may help women to be more active

Although about a quarter of the women mentioned that the online calendar would not help them be more active, most women were able to suggest ways in which it would help them set physical activity goals and increase physical activity.

Motivation and a commitment to exercise

Most women suggested that the online activity calendar was a good motivational source and that they would feel committed to be physically active when using it. This was also consistent with key stakeholder’s views. Women identified several ways in which the calendar was motivational for them and this varied for each woman. Although some women found it encouraging and inspiring, others found it provided pressure to be physically active. A couple of women mentioned that it would ‘guilt’ them into being physically active.

“It would help to keep me motivated and put me back on the right track when I lose the plot” (Verity, 64)

“Encourage me to do more exercise because I can see how little I do” (Erin, 21)

“It could ‘guilt’ me into activity if it showed I wasn’t keeping up with sessions” (Sarah, 42)

“It becomes a self-motivating exercise in itself...It puts pressure on you to achieve your stated goals as well as supports and rewards you when you do” (Key Stakeholder)

Self-monitoring

Numerous women mentioned that the online activity calendar would help them set and monitor their physical activity goals, tracking their progress along the
way. Furthermore, several key stakeholders also identified that the online activity calendar would ensure women plan for their activity.

“Setting and monitoring goals would be so much easier” (Pearl, 57)

“Makes you think about what time you have and where you can fit exercise in. Then you have a schedule that you can follow that suits you” (Adelle, 58)

“By making women plan ahead to ensure exercise is included” (Key Stakeholder)

One woman felt that being able to track her physical activity may help her identify when she is not being physically active enough, at times when she thinks she is.

“By just looking at what I was actually doing – maybe I think I am doing enough but when looking at the calendar it may show I am not really doing that much” (Wilma, 63)

Moreover, a couple of women suggested that the online activity calendar would provide a ‘reminder to exercise’ for when they fail to remember to be active.

“Would remind me what I have to do…” (Cath, 31)

How the online calendar may help reduce sedentary behaviour

About one quarter of women suggested that the online calendar would not help them sit less/reduce sedentary behaviour. Few women could identify ways in which they thought it may help to reduce sitting time, with only one strong theme emerging.
**Self-monitoring**

A couple of women suggested that the online activity calendar would help increase their awareness of how much time they spend sitting by monitoring their goals. However, it was apparent that those women were focussed on displacing sitting time through increasing physical activity, rather than finding ‘standing’ alternatives for completing sedentary activities (e.g. computer use, watching television).

“I could check what I am doing, at the ‘click of a mouse’” (Pearl, 57)

A handful of women also suggested that the online activity calendar would act as a reminder. However, it was again quite evident that most women were focussing on it being a reminder to be active as opposed to strictly reducing time spent sitting.

“Reminds you to be up and about” (Jacqui, 36)

“Keep reminding me of the need to be active” (Bannie, 55)

**Other suggestions to improve the online activity calendar**

Women provided a range of suggestions they felt would improve the online activity calendar.

**Weight loss information**

Several women suggested that the online activity should provide weight loss information and tips, including information on nutrition as well as a calorie counter.
“Tips on nutrition and diet” (Wilma, 63)

Additionally, one key stakeholder suggested that the online activity calendar should include a weight tracker in order to monitor women’s weight loss throughout the year.

“Could have a weight tracker which graphs weight” (Key Stakeholder)

Information on physical activity ideas and facilities

A number of women felt that the online activity calendar should include a section with physical activity ideas and tips for example on overcoming barriers to physical activity, as well as information on local facilities and events, similar to the information provided in the information booklet.

“In addition information about local events e.g. fun runs, walks, bike rides could help to make more use of the calendar” (Jacqui, 36)

“A section with loads of ideas of things to do in various situations e.g. bad weather, injury, recovery from illness, no money” (Bannie, 55)

Link to existing diary system

A couple of women suggested linking the online activity calendar to an i-phone application or to system which people already use (e.g. Microsoft outlook), in order to minimise the number of programs women have to log onto each day.

“Link it to an existing diary system perhaps an application on i-phone or attachment for outlook or similar” (Nicole, 30)
**Printable**

One woman suggested the online activity calendar should be printable in order to use at home, away from the computer.

> “Hopefully sessions like that can be printed for a daily reminder at home”
> (Hilary, 44)

**Preferred Strategy**

The information booklet was by far the preferred strategy for women. Reasons for this included: women’s enjoyment of reading; the fact that is was less time-consuming than the online calendar; and the provision of a range of useful information and tips to be active.

> “The booklet is better for me as it is not as demanding nor exhortative as on-line diary/calendar would be” (Hannah, 45)

> “The information booklet – because you have all the contacts you need, pass it around to friends, organise your own walking group etc” (Louisa, 44)

> “The information booklet was better for me. I like to read and I can keep it handy. I don’t have to keep going back to the computer which I don’t use very often” (Courtney, 43)

However a large proportion of women and key stakeholders also suggested that using the information booklet in conjunction with the online activity calendar would be most preferred since each strategy is quite different.

> “The information booklet is an overall information booklet and good for future reference. The online diary is day to day commitment. I need both to keep me motivated” (Hilary, 44)
“BOTH – I think they go hand-in-hand with each other. The booklet lets you find out activities you can do and the diary/calendar motivates you to uphold your choices and plan” (Orla, 62)

“For me, they’re completely different. The booklet is valuable for its information and the online diary is valuable because it’s a tool to be used for actually scheduling activities mentioned in the booklet. Apples and oranges” (Key Stakeholder)

Strategic most likely to increase physical activity

Most women suggested that the information booklet would be the strategy most likely to increase their physical activity. Women mentioned that it was suitable for all ages, easy to use, as well as including motivating information such as local groups and places to be active.

“The information booklet, because it’s easy to pick up, read and find an activity to do. It’s too easy to get side tracked on the computer and spend more time on it than planned” (Courtney, 43)

“The booklet is easy to sit and read, more suitable to all ages and quicker to find information you need” (June, 60)

“Info booklet – Gives reasons why you should be active and where you can be in the local area” (Natalie, 48)

Nevertheless, a number of women stated that the online activity calendar would be most likely to increase their own physical activity due to the provision to plan for physical activity, monitor progress and use it for motivation.

“Online diary because it is a tool to plan, act, check, review, etc. Whereas the booklet is not interactive or a planning document” (Bannie, 55)

A few women also suggested that using both the information booklet and online calendar would be most beneficial in increasing their physical activity, with a key
stakeholder also mentioning that a combination would be best.

“For me, both are important. I like reading, will have information booklet on hand for reference whereas computer not always on, but like to sit down for a break and record daily effort and look at what’s planned ahead at end or beginning of day” (Verity, 64)

“Both could be beneficial – the booklet to give the initial information and diary to help get and stay motivated” (Key Stakeholder)

Strategy most likely to reduce sedentary behaviour

Again, most women felt that the information booklet would be the strategy most likely to reduce sitting time, due to the tips/suggestions it provides women. In fact, one woman mentioned that the online calendar would actually increase her sitting time.

“The booklet gives you ideas to cut down sitting time, a good physical activity would be walking children to school and back again” (June, 60)

“Booklet. Hate to say it but the online diary is only going to make more sitting time” (Rachel, 45)

Other suggestions to increase physical activity and reduce sedentary behaviour

When asked about having any other ideas to increase women’s physical activity and/or reduce sedentary behaviour, a number of suggestions were mentioned to increase physical activity. These encompassed intra-personal, social and physical environmental strategies. However, no additional suggestions were made for reducing sedentary behaviour.
Social support for physical activity in the community

Women suggested having more age-specific social activity groups in the area would help increase physical activity.

“Living on my own is less motivating...Perhaps group activities on a regular basis and with variable times would be advantageous in my age group” (Gertrude, 62)

Although one woman mentioned that she would like having greater access to physical activities with children, another woman suggested that a women’s social group without kids would help her be more physically active.

“Have more activities where kids can go, like fun days in the park” (Cath, 31)

“There is a men’s shed. If we had a women shed, for women to get together without children, they could talk, make friends and get out and do things as a team?” (June, 60)

Accessibility to facilities

Several women and key stakeholders mentioned that access to free or cheap activities in the area would help them become more physically active. Cheaper exercise classes and gym memberships were suggested in order to help women initially start exercising, particularly those on low incomes or the pension.

“When women are on low incomes, pensions etc, gyms/pools are often too expensive and not an option even if desired. I am motivated to be fit but do not have money for these types of exercises anymore...” (Orla, 62)

“Maybe some free memberships for a month to health club/health group to get women started because it’s the initial motivation that is important. The benefit of exercise then is the motivation” (Natalie, 48)

A number of women also mentioned that increasing the variety and availability
(opening times) of age-specific physical activities offered in the community would help them be more active.

“Organised community events targeted at different groups. Too many activities are aimed at groups like “young mums or over 50’s”. What about things which appeal to women between 30-50 who have a higher education. Seems not to be too much on offer for women in that demographic” (Jacqui, 36)

“Some cooler exercise groups in town like karate or boxing for women, not just yoga and tai chi – boring” (Cath, 31)

“Activities in the evenings for women who work. Part-time work to allow time for more physical activity” (Key Stakeholder)

**Increased information**

One woman suggested that information sessions held at the various activity venues would help increase physical activity. Furthermore, the distribution of information for being physically active in the community was suggested by a couple of key stakeholders as an important factor in increasing awareness in the community.

“Info sessions held at each venue” (Irene, 54)

“Not just produce informative books/web sites like this but make sure women actually receive them or know they are available. Information centres, mums groups, crèche, kindergartens/schools, community centres etc” (Key Stakeholder)

**7.5. Discussion**

The aim of the current study was to investigate the perceived feasibility of two proposed intervention approaches (one print-based and one web-based) designed to promote physical activity and reduce sedentary behaviour amongst women
living in socio-economically disadvantaged areas. Furthermore, the study aimed
to investigate the feasibility the two proposed intervention strategies amongst a
small sample of key stakeholders.

There is a lack of research testing the effectiveness or even feasibility of
intervention strategies aimed at promoting physical activity and reducing
sedentary behaviour in women living in socio-economically disadvantaged
neighbourhoods, a group at high risk of inactivity (Armstrong, Bauman, &
Davies, 2000; Bensenor, Rexrode, & Manson, 1999) and of depression (Scarinci
et al., 2002; Weissman & Olfson, 1995). Furthermore, increasing evidence,
consistent with the social ecological model (Sallis & Owen, 1999), attests to the
importance of factors within the neighbourhood environment as influences on
physical activity (Trost et al., 2002), but few studies have tested this in an
intervention-based approach. Since a reduction of sedentary behaviours/adopting
of physical activity may offer substantial health benefits to women living in
socio-economically disadvantaged neighbourhoods, including the potential to
reduce the risk of depression (Teychenne, Ball, & Salmon, 2008b), it is important
to identify the most effective strategies to promote healthy behaviours amongst
this high-risk target group. Qualitative methods are useful for investigating areas
in which little is known, and therefore the qualitative design of this study was able
to provide valuable information and novel evidence regarding these important
research gaps.
Information booklet: Comprehensible for disadvantaged women

The findings of this study suggested that the information booklet was perceived by women and key stakeholders as a feasible strategy to provide information about the health outcomes of being physically active and reducing sitting time, practical ideas to increase levels of physical activity and reduce sitting time, as well as locally relevant information about the availability of physical activity facilities and recreational clubs. Since living in socio-economically disadvantaged neighbourhoods is generally associated with low education (including literacy) levels (Galobardes et al., 2006a), the information booklet used in the current study was designed to ensure good readability, with the use of simple language, as well as included numerous pictures and graphic illustrations of ideas. Most participants suggested that the information booklet was easy to read, understand and well presented, with interesting photos and pictures to enhance comprehension and visual engagement.

In one previous intervention study, the use of self-instructional reading (information) materials was found to be an effective strategy for increasing walking amongst disadvantaged women (including ethnic minority women) (Chen et al., 1998). Similar to the current study, reading materials were based on the principles of behaviour change and included information on the health risks of being inactive, instructions on how to begin a walking program, as well as tips on how to overcome barriers to physical activity. An interesting finding from that study was that women who received telephone counselling in addition to the reading (information) materials did not increase their walking significantly more
than the women who only received the reading (information) materials. This suggests that information booklets aimed at increasing physical activity may be an effective ‘stand-alone’ strategy which is cost-effective for disadvantaged women, provided that information is presented in a comprehensible style.

**Weight loss information**

A common theme that emerged from the current study was the women’s desire for weight loss tools and information to be included within both the information booklet as well as the online activity calendar. Women were particularly interested in using the proposed interventions for the purpose of losing or managing weight and expressed their desire for access to nutritional information, weight trackers and calorie counters. Since women living in socio-economically disadvantaged areas are at a greater risk of overweight and obesity than women from higher socio-economic areas (McLaren, 2007), this may be an important component that could provide additional motivation in interventions aimed at increasing physical activity and reducing sedentary behaviour amongst disadvantaged women. A number of information-based weight-loss interventions in the general population have been effective in increasing physical activity (Plotnikoff et al., 2005) as well as facilitating weight loss (Wylie-Rosett et al., 2001) which provides further impetus for testing such strategies within a sample of disadvantaged women. Moreover, overweight and obesity have been found to be positively associated with depression amongst women (Linde et al., 2004) and therefore physical activity interventions that include additional weight loss strategies may also be effective in helping reduce the risk of depression amongst
socio-economically disadvantaged women.

**Tailoring information to the individual**

Although most women thought that the information booklet contained all the information they needed to be active in their neighbourhood, a small number of women disagreed and suggested that the booklet lacked information relevant to their personal needs, age and/or lifestyle (e.g. it did not present much information on classes available after work hours). Individual tailoring of information has been found to be a successful strategy for increasing physical activity as it increases the personal relevance of physical activity interventions for various sub-groups (Chen et al., 1998; Marcus et al., 1998b; Marcus & Forsyth, 1998). For example, previous studies have shown that minimal self-help interventions that were individually tailored (i.e. motivationally-matched materials) were more effective in increasing participant’s motivational readiness for, and time spent in physical activity than standard (non-tailored) self-help interventions (Marcus et al., 1998a; Marcus et al., 1998b).

In the study by Chen and Colleagues (1998), it was found that providing print information on overcoming barriers to physical activity aimed specifically for ethnic minority women was effective in increasing women’s physical activity. Since physical activity interventions for women tend to be more efficacious when targeted to the needs, lifestyle and interests of women (Booth et al., 1997), the findings of the current study indicate that perhaps tailoring booklets to various
age-groups (e.g. young women, middle-aged women, older women) may be more appropriate. Nonetheless, exhaustive searches of local facilities were conducted, and to the Candidate’s knowledge, all local physical activity recreational clubs, classes and facilities were included in the information booklet in this study, suggesting that there was in fact a real lack of access and opportunities for older and working women to be physically active in the targeted neighbourhood. Therefore, other social and physical environmental strategies for promoting physical activity (e.g. increasing availability of age-appropriate exercise classes) may be needed within the targeted community. This was further evident from women’s suggestions for the need of increased social support for physical activity in the community (i.e. social recreational clubs) as well as an increased number of accessible facilities.

**Tailoring the delivery method of the information booklet**

Although just over half the women in this study felt that the information booklet would be best delivered through monthly leaflets in the mail, it was apparent that additional methods were favoured by a number of other women, including all-in-one reference books, websites, e-mails and i-phone applications. This finding highlights the notion that different delivery methods are needed to suit different women’s needs, lifestyles and ages. This is consistent with conclusions drawn by Booth et al. (1997), who suggested that community-wide physical activity promotion strategies are more likely to be successful when tailored to the attributes of target groups. For example, it could be that low-income women and older women may be suited to print-based delivery methods, whilst younger and
working women may be more suited to web-based or mobile phone-based delivery methods, rather than a ‘one size fits all’ approach. Considering a large proportion of participants in the current were of an older age (i.e. 57% of the sample were aged 50 years and over), this may have had an impact on the appeal of web-based or other technology-based delivery modes. Further research is needed with a wider age range and larger sample to better understand the needs of different sub-groups.

**The concept of sedentary behaviour**

Consistent with the findings from Chapter 5, many women in the current study felt that strategies to reduce sedentary behaviour were not practical. Several women and key stakeholders suggested that the tips provided, such as standing at your computer (rather than sitting), were impractical and unrealistic. The concept of reducing sedentary behaviour for health benefits is a relatively new area of research and public health focus, and therefore a large proportion of the population may be unfamiliar with it. It is therefore important to promote more broadly the independent health risks linked to engaging in long periods of sedentary behaviour, for instance through large scale mass media and social marketing campaigns. In the current study, several ideas for information to increase physical activity were suggested; however, very few women were able to suggest ideas on other information that may help them reduce their sedentary behaviour (sitting time). This further highlighted the fact that women were unfamiliar with the idea of reducing sedentary behaviour. Despite this, it was promising that a number of women were interested in learning more about the
health risks as well as additional tips to reduce time spent in sedentary behaviour, indicating that through awareness raising, education and health promotion the idea of reducing sedentary behaviour may be accepted by women living in socio-economically disadvantaged neighbourhoods.

**Online activity calendar – Tailored but time-consuming**

Women suggested that the online activity calendar was useful for monitoring physical activity goals as well as a motivational tool to be active. Furthermore, a number of women expressed the appeal of the fact that it was a personalised website and tailored to the individual (an important component of physical activity interventions – see discussion above). Since tailored web-based interventions have been shown to be successful in increasing physical activity (Marcus et al., 1998a; Napolitano et al., 2003) and reducing sedentary behaviour (Marshall et al., 2003) amongst adults, the findings of this study provide further support for testing such approaches amongst women and disadvantaged populations. However, many women in the current study were of the opinion that the online activity calendar would be too energy- and time-consuming to use. Consistent with findings from Chapter 5, as well as previous studies (Ball et al., 2006; Brown et al., 2001b; Juarbe, 1998), time constraints have been perceived as a major barrier to physical activity amongst socio-economically disadvantaged women. Therefore, it is important to design interventions that promote physical activity without being time-consuming. One strategy that was mentioned by a couple of women to overcome this barrier was to link the online activity calendar to an existing diary system that women may already use on a day-to-day basis.
(e.g. Microsoft outlook or an i-phone application). Since there is an increasing reliance on technology-based products (e.g. mobile phones, internet), this may be an important consideration in the development of intervention strategies.

**Preferred strategy**

The information booklet was perceived as the preferred and most feasible strategy for increasing physical activity and reducing sedentary behaviour amongst women. Reasons for this included the fact that it was less time-consuming than the online calendar as well as that it provided a considerable amount of useful information and suggestions to encourage an active lifestyle. However, a number of women saw the value in both intervention strategies and felt that both the information booklet and the online activity calendar should be used together and would complement each other. Consistent with previous recommendations for children and adults (Kahn et al., 2002), the findings of this study suggest that a multi-component approach (i.e. utilising two or more strategies) may be the most successful method to increase physical activity and reduce sedentary behaviour amongst women living in socio-economically disadvantaged neighbourhoods.

**7.5.1. Limitations**

When interpreting the results of this study, a number of limitations should be considered. Firstly, the study relied on self-report measures to assess physical activity, sedentary behaviour, and risk of depression, as well as women’s views on the perceived effectiveness and feasibility intervention materials. Therefore, factors such as recall difficulties, error in judgment and in particular socially
desirable responses (e.g. women over-reporting the likelihood of using intervention materials) potentially limit the results.

Secondly, socio-economic position was defined using an area-based measure. Therefore, a number of participants were not considered to be socio-economically disadvantaged based on individual level indicators such as income or education (e.g. just over half of participants had completed a university degree). Nevertheless, area-based indicators of socio-economic position have been linked to lower leisure-time physical activity, independent of individual socio-economic indicators (van Lenthe, Brug, & Mackenbach, 2005).

Thirdly, most of the women in the current study were already quite active (the mean time spent in weekly leisure-time [walking, moderate and vigorous] physical activity = 4.5 hours). Therefore, the recruitment of an inactive sample who were really trying to adopt physical activity, rather than further increase an already active lifestyle, may have yielded different results.

Finally, the current study initially targeted a high-risk and typically hard to reach group (women living in socio-economically disadvantaged neighbourhoods and at risk of depression). It also involved completing a number of open-ended questions, which pose a reasonable response burden on participants. Therefore, it was not surprising that the study had a very low response rate (5%), with only five of the 37 respondents (13.5%) reporting being at risk of depression. The recruitment strategies adopted in this study (a mail-out of surveys to random
households, addressed “To the resident”, as well as posters displayed in community centers/neighbourhood houses) have been used in previous studies of disadvantaged adults; however, generally they have been used in conjunction with other recruitment methods. For example, one cohort study successfully recruited 32,632 disadvantaged participants through the use of flyers/posters at 25 local community health centers across the U.S over two years (Signorello et al., 2005). However, that study adopted additional interactive recruitment strategies such as having the researchers approach individuals and groups of people waiting at the health centers, as well as medical and reception staff providing referrals to patients. Additionally, amongst another hard-to-reach group (i.e. mothers with children with disabilities) it was found that, consistent with the current study and that of a previous study amongst disadvantaged women (Cleland & Ball, 2010), recruiting via a large non-personally addressed/tailored mail-out yielded a low response rate (Patrick, Pruchno, & Rose, 1998). Thus, future research may need to utilise more personally-tailored recruitment strategies (e.g. including women’s full names in addressed letters). However, we did not have access to these details for this study.

Nonetheless, ethical considerations during recruitment, particularly relating to the purposeful recruitment of disadvantaged or depressed populations, can limit recruitment through such interactive strategies within health/medical centers (National Health and Medical Research Council, Australian Research Council, & Australian Vice-Chancellors' Committee, 2007). Thus, the poor response rate of the current study highlights the need for further research on more effective recruiting
strategies for reaching high risk and hard-to-reach target groups such socio-
economically disadvantaged women (Freimuth & Mettger, 1990; Madigan et al.,
2000) as well as those at risk of depression (Clark et al., 1983; Williams &
Macdonald, 1986) in research studies.

7.5.2. Strengths

Since little research has examined the most effective and feasible strategies for
increasing physical activity and reducing sedentary behaviour amongst
disadvantaged women, a major strength of the current study was the qualitative
design, which provided detailed insights not possible from quantitative
approaches. Furthermore, the inclusion of women from socio-economically
disadvantaged neighbourhoods in this study provided novel insights in an
important group for this research given that socio-economically disadvantaged
women are at risk of physical inactivity (Armstrong, Bauman, & Davies, 2000)
as well as illnesses potentially related to inactivity such as depression (Scarinci et
al., 2002).

Moreover, the current study tested the feasibility of ‘minimal’ intervention
strategies that may be widely distributed to large numbers of people, as well as
being relatively inexpensive and non-intensive (Chen et al., 1998). Thus, these
strategies may be more appropriate to implement within socioeconomic
disadvantaged communities than more expensive or intensive/time-consuming
strategies. Finally, the intervention strategies were developed in accordance with
the social ecological model (Sallis & Owen, 1999), building on the insights from
women living in disadvantaged neighbourhoods and experiencing depressive symptoms (Chapter 5). Since sizeable proportions of the population within Australia live in disadvantaged areas (Australian Bureau of Statistics, 2006b) and/or experience depressive symptoms (Byles et al., 2008), these strategies may be effective for a large number of women in increasing physical activity/reducing sedentary behaviour and in turn reducing the risk of depression.

7.5.3. Future research/implications

The findings of the current study have potential implications for socio-economically disadvantaged women’s physical activity promotion and research. The study provided support for the dissemination of locally-relevant and individually-tailored information booklets as a strategy to increase physical activity and reduce sedentary behaviour amongst this target group. More specifically, it was found that including weight loss information, as well as tailoring the information and delivery mode of the booklet (i.e. print, web-based) may be useful in increasing the success of the intervention strategy. Moreover, a multi-component approach (i.e. utilising an information-based strategy in conjunction with a web-based activity planner) may further increase physical activity adoption and reduction of sedentary behaviours amongst women living in disadvantaged neighbourhoods. However, following further larger formative studies and pilot testing, intervention studies using appropriate methods (e.g. randomised controlled trials) are needed to test the effectiveness of the proposed strategies.
It was clear that the concept of ‘reducing sedentary behaviour’ was new to women in this study and most appeared unable to distinguish the difference between ‘physical inactivity’ and ‘sedentary behaviour’. Therefore, increasing promotion and education about the independent health risks linked to engaging in long periods of sedentary behaviour, as well as strategies to reduce sedentary behaviour, may be important considerations for future health promotion research amongst women living in disadvantaged neighbourhoods. Furthermore, due to the difficulty in recruiting socio-economically disadvantaged women with depressive symptoms, it is evident that further research is needed on identifying more effective recruiting strategies for these high-risk and hard-to-reach target groups, and for recruiting women across different age groups and life stages.

In brief, this study provided novel qualitative findings that could inform future intervention strategies to increase physical activity, reduce sedentary behaviour, and in turn reduce the risk of depression for women living in socio-economically disadvantaged neighbourhoods.
CHAPTER 8: Conclusions

In this thesis, physical activity and sedentary behaviours were examined amongst socio-economically disadvantaged women to provide a deeper understanding of how these behaviours might contribute to their increased risk of depression. Within this research, four inter-related studies were conducted to explore the associations between components of physical activity, sedentary behaviour and risk of depression, to determine the influences on physical activity and sedentary behaviour amongst disadvantaged women with depressive symptoms, to identify the mediating factors which may help explain the inverse relationship between socio-economic position and women’s sedentary behaviour, and to test the perceived feasibility and effectiveness of potential strategies to increase physical activity and reduce sedentary behaviour amongst socio-economically disadvantaged women. The findings presented in this thesis contribute to the evidence base necessary to inform the development of interventions aimed at increasing physical activity and reducing sedentary behaviour in order to reduce the risk of depression amongst socio-economically disadvantaged women. Since extensive discussion of the specific findings and issues has been presented within each of the previous chapters, this final chapter provides a synthesis of the thesis findings and their implications as a whole.
8.1. Overview of findings

*Physical activity and depression*

The extensive review of the literature in Chapter 2 demonstrated that although a large body of evidence indicates an inverse relationship between physical activity and depression in women, studies assessing the relationship between other domains of physical activity and depression were limited, and findings inconsistent. The findings from Chapter 4 showed that undertaking a high dose of leisure-time physical activity and transport-related physical activity was associated with a lower risk of depression, whilst no associations were found between domestic or work-related physical activity and depression. Thus, it was suggested that promoting physical activity, in particular for leisure and transport, could be an important aspect in preventing depression.

Since much research into the relationship between physical activity and depression has utilised cross-sectional study designs (Teychenne, Ball, & Salmon, 2008b), causality and the direction of relationships have often been unable to be determined. However, findings from Chapter 5 suggested that the relationship between physical activity and depression may be bi-directional. That is, women perceived that physical activity reduced feelings of depression, enabling them to feel ‘happier’. However, when feeling severely depressed, women’s physical activity levels would in turn dramatically decrease as they struggled to undertake even basic everyday activities. This highlights the importance of identifying strategies to promote physical activity, particularly to
women at risk of depression, such as those of a low socio-economic position (Scarinci et al., 2002).

**Social aspects of physical activity**

Due to limited and inconsistent research, the review of the literature (Chapter 2) was unable to conclude an optimal social context of physical activity for conferring mental health benefits among socio-economically disadvantaged women. Findings from Chapter 4 suggested that additional mental health benefits may come from undertaking some leisure-time PA with someone else. However, findings from that study showed that not all physical activity with others was associated with a lower risk of depression. This is consistent with our previous findings from the only other cross-sectional study that has examined the association between the social context of physical activity and risk of depression (Teychenne, Ball, & Salmon, 2008a), in which we found that being active with a family member was associated with a lower risk of depression, yet being active with a friend was not. Since a lack of social support is widely known to be linked to lower levels of depression (Nasser & Overholser, 2005), the social context of physical activity may be an important component in the relationship between physical activity and depression. The findings of this thesis therefore concur with the preliminary recommendations for promoting physical activity to reduce/manage depression in adults, which suggest that physical activity should be performed in groups (National Institute of Clinical Excellence, 2009).
Further impetus for promoting social support and social physical activity amongst socio-economically disadvantaged women was provided by the findings of Chapters 3 and Chapters 5-7. The review of the literature (Chapter 3) highlighted that a lack of social support was a key barrier to physical activity among socio-economically disadvantaged women, and that several physical activity interventions aimed at reducing depressive symptoms included social strategies such as group-based exercise sessions, and/or coaches to increase adherence to programs. Moreover, qualitative findings from Chapter 5 indicated that social support from friends and family was perceived as influencing women’s physical activity in three ways; by increasing enjoyment, motivation, and opportunities to be active. Considering that social support from friends and social cohesion were found to mediate the relationship between socio-economic position and television viewing (Chapter 6), and that a number of social strategies (e.g. family and friend support, mothers physical activity groups, women’s only gyms, more social exercise facilities) were suggested by disadvantaged women in Chapters 5 and 7 to increase physical activity and reduce sedentary behaviour, this PhD provides extensive evidence for the need of supportive social environments when promoting physical activity and reducing sedentary behaviour amongst women living in disadvantaged neighbourhoods, particularly those at risk of depression.

*Sedentary behaviour and depression*

Although the findings of the review of the literature (Chapter 2) were not unequivocal, on the whole they were suggestive of a positive association between sedentary behaviours and risk of depression amongst adults. Evidence for this
positive relationship amongst socio-economically disadvantaged women was further provided by the quantitative findings in Chapter 4, which suggested that screen-based sedentary behaviours (including computer use) and overall sitting time were associated with an increased risk of depression. Since the causality and mechanisms linking sedentary behaviour and depression could not be determined due to the cross-sectional nature of this study, the qualitative findings of Chapter 5 provided important insights. In short, that study suggested that amongst socio-economically disadvantaged women with depressive symptoms, the relationship between sedentary behaviour and depression was not explained by television viewing causing an increase in depressive symptoms; rather women suggested that their depressive symptoms increased their engagement in television viewing. The women perceived that television viewing helped them to relax and eased their depressive symptoms by distracting their negative thoughts. This concept of “switching on to switch off” may partly explain findings from Chapter 6 which indicated that the positive relationship between socio-economic position and women’s television viewing was mediated by enjoyment of television viewing. Thus, this research may suggest that providing socio-economically disadvantaged women with enjoyable alternatives for relaxation purposes may be an important strategy to reduce television viewing.

The concept of sedentary behaviour

Findings from both qualitative studies (Chapters 5 and 7) suggested that socio-economically disadvantaged women had little knowledge of the concept of ‘reducing sedentary behaviour’. Women often misinterpreted the term ‘sedentary
behaviour’ as ‘lack of physical activity’ with many finding it difficult to identify strategies to reduce sedentary behaviour. Following the social ecological model, findings from Chapter 5 indicated that although women were able to identify a range of intra-personal, social and physical environmental influences on their physical activity, they mentioned far fewer influences on their sedentary behaviour. This may be due to women being less exposed to the concept since sedentary behaviour has received significantly less social marketing and promotion than has physical activity. Despite this, it was promising that a number of women were interested in learning more about the health risks as well as additional tips to reduce time spent in sedentary behaviour, indicating that through education and health promotion the idea of reducing sedentary behaviour may be accepted and practiced by women living in socio-economically disadvantaged neighbourhoods.

**Time constraints**

Consistent with the review of the literature (Chapter 3), findings from Chapter 5 and Chapter 7 indicated that time constraints were a key influence on women’s health behaviours (i.e. physical activity and sedentary behaviour). In particular, in Chapter 5 mothers tended to put their families’ needs before their own and often perceived their own physical activity as a low priority, which is consistent with previous research amongst disadvantaged women (Juarbe, 1998; Welch et al., 2009). Furthermore, in Chapter 7, several women suggested that the online activity calendar would be too time-consuming to use. However, although women mentioned having a lack of time was a barrier to being physically active, several
women in Chapter 5 suggested ‘multi-tasking’ as a strategy they used to increase physical activity and in particular reduce sedentary behaviour. Thus, incorporating such strategies into physical activity and/or sedentary behaviour interventions for socioeconomically disadvantaged women at risk of depression may be an important point of consideration.

Weight status

One other theme which was evident across studies was women’s weight. Chapter 3 highlighted the large body of evidence that has suggested a positive relationship between being overweight and television viewing in adults, with findings from Chapter 6 further indicating women’s weight status as a mediating factor in the socio-economic/television viewing gradient. Moreover, much of the feedback provided by women in Chapter 7 suggested that there was an appeal for weight loss tools and information to be included in physical activity/sedentary behaviour interventions (i.e. both the information booklet and online activity calendar). Since overweight and obesity have been found to be positively associated with depression, particularly amongst women (de Wit et al., 2010a; Luppino et al., 2010), physical activity/sedentary behaviour interventions that include additional weight loss strategies may be increasingly effective in reducing the risk of depression amongst socio-economically disadvantaged women, a population group at risk of depression.
Effective strategies to increase physical activity and reduce sedentary behaviour

The findings from Chapter 7 indicated that a comprehensive, locally relevant and individually tailored (i.e. tailoring delivery methods and providing age-specific information) information booklet, based on the social ecological model (Sallis & Owen, 1999) may be a feasible strategy to increase physical activity and reduce sedentary behaviour amongst socio-economically disadvantaged women. Furthermore, although living in socio-economically disadvantaged neighbourhoods is generally associated with low education (including literacy) levels (Galobardes et al., 2006a), the use of simple language and graphics was perceived to be effective in enhancing readability. Moreover, consistent with previous research (Albright et al., 2005), a multi-component approach (i.e. utilizing an information-based strategy in conjunction with a web-based activity planner) may be an effective strategy to increase physical activity adoption and reduction of sedentary behaviours amongst socio-economically disadvantaged women.

8.2. Limitations and strengths of this PhD

In interpreting the findings of this thesis, several limitations should be acknowledged. Firstly, the cross-sectional design of two of the four studies meant that the causality or the direction of relationships was unable to be determined. However, since little research has explored these aspects, cross-sectional findings provide important insights in this research area. Moreover, the qualitative design of the subsequent studies allowed for further exploration of several of those relationships, providing evidence for perceived causal pathways. However,
further prospective studies are needed to confirm causality of associations, in particular the relationship between components of physical activity, sedentary behaviour and risk of depression amongst socio-economically disadvantaged women.

A second limitation is that self-report measures were used to assess physical activity, sedentary behaviour and risk of depression in all studies. Although valid and reliable measures were used where possible, recall difficulties, error in judgment and socially desirable responses potentially limit the results. Furthermore, it is not known how the accuracy of reporting varies according to mood state. Future studies could utilize objective measures such as Actigraph accelerometers and activPAL inclinometers for assessing physical activity and sitting time respectively.

Thirdly, the low response rates in studies in Chapter 5 and 7 highlighted the fact that socio-economically disadvantaged women with depressive symptoms are a high-risk and hard-to-reach target group for research. For example, Chapter 7 resulted in a low response rate (5%), with only five of the 37 respondents (13.5%) reporting being at risk of depression. The recruitment strategies adopted in that study had been used in previous studies of disadvantaged adults; however, generally they had been used in conjunction with other recruitment methods. This highlights the need for further research on more effective recruiting strategies for high-risk and hard-to-reach target groups such socio-economically disadvantaged
women (Freimuth & Mettger, 1990; Madigan et al., 2000) and those at risk of depression (Clark et al., 1983; Williams & Macdonald, 1986).

One of the major strengths of this PhD is the multi-method approach employed to examine various aspects of physical activity, sedentary behaviour and risk of depression amongst socio-economically disadvantaged women. Cross-sectional studies provided descriptions of associations between components of physical activity, sedentary, and risk of depression, as well as identifying potential mediators which may explain the socio-economic-sedentary behaviour gradient. These studies provided novel insights as well as a rationale for further research investigating those relationships. The qualitative studies explored the influences on physical activity and sedentary behaviour amongst disadvantaged women with depressive symptoms, as well as the perceived feasibility of potential intervention strategies to increase physical activity and reduce sedentary behaviour in this target group. Since qualitative methods are useful for investigating areas in which little is known, the qualitative design of these studies was chosen in order to provide rich insights for the identification and development of strategies to promote physical activity and reduce sedentary behaviour amongst socio-economically disadvantaged women, particularly those at risk of depression.

Secondly, studies in this thesis were based on well-established theories of behaviour change, with most studies developed around the social ecological framework, which is useful in guiding research into the intra-personal, social and environmental correlates of physical activity and sedentary behaviour (Sallis &
Theoretically-based research is important as it allows us to draw on, compare, and build upon previous theory-driven research, thus providing a comprehensive understanding of the influences and/or mediators of behaviours, as well as enabling the identification of key components to be targeted when developing interventions (Glasgow et al., 2004). Further, the intervention approaches that were tested in Chapter 7 were based on well-established behaviour change techniques (e.g. goal-setting, self-monitoring (Hardeman et al., 2000)) as well as on the candidate’s preliminary findings.

Finally, the studies included in this thesis contribute novel and relevant evidence to the field. Since socio-economically disadvantaged women are at an increased risk of both depression (Lorant et al., 2003; Wilhelm et al., 2003) and inactivity (Armstrong, Bauman, & Davies, 2000; Bensenor, Rexrode, & Manson, 1999), they are an important target group for research. Prior to this PhD, little was known about the most appropriate domain and social context of physical activity for conferring mental health benefits amongst disadvantaged women. Furthermore, this thesis was among the first to assess the relationship between sedentary behaviour and risk of depression, as well as explore the influences on physical activity and sedentary behaviour amongst disadvantaged women with depressive symptoms. To the candidate’s knowledge, this thesis was the first to examine the role of intra-personal, social and physical environmental factors in explaining the socio-economic inequalities in women’s television viewing. Additionally, no previous studies have tested the perceived feasibility of theoretically-based intervention materials aimed to increase physical activity as
well as reduce sedentary behaviour amongst socio-economically disadvantaged women. Therefore, the findings of this research have potential implications for the development of interventions, strategies and recommendations aimed at increasing physical activity, reducing sedentary behaviour and in turn reducing the risk of depression amongst socio-economically disadvantaged women.

8.3. Implications of future research and practice

This thesis has contributed to the limited evidence base examining physical activity, sedentary behaviour and risk of depression amongst socio-economically disadvantaged women. It has increased our understanding of the components of physical activity (social context and domain) most likely to reduce the risk of depression, as well as the sedentary behaviours most likely to be associated with an increased risk of depression, amongst a high-risk target group. Furthermore, it has provided us with a better understanding of the intra-personal, social and physical environmental influences on physical activity and sedentary behaviour amongst disadvantaged women with depressive symptoms, as well as the factors which mediate the inverse relationship between socio-economic position and women’s television viewing. Thus this thesis enabled the identification of a number of strategies that may be used to increase physical activity and reduce sedentary behaviour amongst women living in disadvantaged neighbourhoods, particularly those at risk of depression. This information then guided the development of intervention strategies, allowing us to better understand the most feasible approaches to promoting an active lifestyle and reducing sedentary time amongst disadvantaged women, a high-risk group for inactivity and depression.
**Future research opportunities**

Since this research is among the first to examine these important aspects, there are considerable opportunities for future research. Further longitudinal and intervention studies are needed to confirm the associations observed between the domain and social context of physical activity, sedentary behaviours and risk of depression amongst socio-economically disadvantaged women. This can provide important information regarding the causality of those relationships and will help identify the most appropriate physical activities to promote as well as identify which aspects of sedentary behaviour to reduce in order to reduce depressive symptoms. For example, there may be something unique about screen-time that is important to target, or alternatively it may the accumulation of overall sedentary behaviour throughout the day that is most important to target in order to reduce depressive symptoms. Additionally, since increased breaks in sedentary time have been shown to be inversely associated with overweight/obesity, triglycerides and 2-h plasma glucose (Healy et al., 2008a) it may be the patterns of accumulation of sedentary behaviour that are most important to target to reduce depressive symptoms. Similarly, further research investigating the optimal dose of physical activity and considering the way in which it may be accumulated (e.g. 10 minute bouts of incidental activity versus sustained and/or structured activity) to reduce the risk of depression is needed. Moreover, such studies will enhance our understanding of the underlying mechanisms which may explain the relationship between physical activity, sedentary behaviour and depression.
Considering research identifying the influences on sedentary behaviour is still in its infancy, further studies examining the intra-personal, social and physical environmental correlates of sedentary behaviour amongst socio-economically disadvantaged women are particularly important. Moreover, since this thesis was the first to examine the role of intra-personal, social and physical environmental factors in explaining the socio-economic inequalities in women’s television viewing, further research is required to confirm these findings, as well as test the causality of these relationships. Given that no physical-environmental mediators were found to mediate the relationship between socio-economic status and women’s television viewing, further studies could also examine the physical environmental mediators in more depth, utilising objective environmental indicators such as GIS (Geographic Information System) technologies. Increasing this evidence base will help to inform future intervention strategies to effectively reduce sedentary behaviour amongst at-risk target groups such as socio-economically disadvantaged women with depressive symptoms, thus reducing the socio-economic inequalities in women’s health. Although this thesis was able to test the perceived feasibility of intervention strategies aimed at increasing physical activity and reducing sedentary behaviour amongst women living in socio-economically disadvantaged neighbourhoods, randomised controlled trials are needed to test the effectiveness of the proposed strategies.

**Implications for practice**

There are several key findings that have potential implications for informing future recommendations and the development of interventions strategies. The
results of this PhD suggest that promoting physical activity, particularly for leisure and transport, could be an important aspect in preventing depression amongst women living in disadvantaged neighbourhoods. Furthermore, mental health guidelines may be further developed to include not only some aspect of social/accompanied leisure-time physical activity for additional mental health benefits, but also a recommendation for reducing time spent in sedentary behaviours (i.e. screen time), in order to further reduce risk of depression. Promoting social/accompanied physical activities during leisure-time may also help in increase adoption and maintenance of physical activity programs (Sallis, Hovell, & Hofstetter, 1992) and may in turn displace time spent in sedentary behaviours (Hu et al., 2003).

Since physical activity and sedentary behaviours amongst socio-economically disadvantaged women with depressive symptoms are influenced by several intra-personal, social and physical environmental factors, there is a need for dynamic and multi-dimensional strategies, encompassing constructs of the Social Ecological Model (Sallis & Owen, 1999) to increase physical activity and reduce sedentary behaviour. Factors including time constraints, social support, children, and availability of facilities may need to be considered when designing programs to promote physical activity and reduce sedentary behaviour. Thus, potential intra-personal strategies to promote these behaviours may include education and public awareness campaigns about reducing sitting time at home and work, as well as the benefits of participating in regular physical activity; social strategies may involve promoting family and friend support for an active lifestyle as well as
specialised exercise groups such as new mother’s walking groups; and physical environmental strategies may include more women’s only gyms/exercise classes as well as providing information on available facilities in the local area.

Interventions aimed at reducing the socio-economic inequalities in women’s television viewing in particular, may need to focus particularly on intra-personal and social influences. Strategies may include supporting women to identify and participate in enjoyable relaxation alternatives to television viewing, such as meditation, yoga, stretching, gardening or walking; focusing on weight-loss and weight-management approaches by providing resources to support healthy eating and physical activity, social support for weight loss, and counselling/assistance with overcoming barriers to healthy lifestyles; enhancing social cohesion and social support from friends within disadvantaged neighbourhoods, for instance by implementing walking groups, social support groups or encouraging other social activities. Considering factors such as social support (Nasser & Overholser, 2005) and weight loss (Luppino et al., 2010) have been associated with lower levels of depression, these strategies may be particularly important in not only reducing sedentary behaviour, but also reducing depression risk.

The findings of this thesis suggest that a locally-relevant and individually-tailored information booklet intervention may be a feasible strategy to increase physical activity and reduce sedentary behaviour amongst this target group. More specifically, including weight loss information, as well as tailoring the information and delivery mode of the booklet (i.e. print, web-based) may be
useful in increasing the success of the intervention strategy. Moreover, a multi-component approach (i.e. utilizing an information-based strategy in conjunction with a web-based activity planner) may further increase physical activity adoption and reduction of sedentary behaviours amongst women living in disadvantaged neighbourhoods. However, intervention studies are needed to test the effectiveness of the proposed strategies.

Finally, future research should focus on increasing promotion and education about the independent health risks linked to engaging in long periods of sedentary behaviour, as well as identifying more effective recruiting strategies for high-risk and hard-to-reach target groups such as women living in disadvantaged neighbourhoods as well as those at risk of depression.

8.4. Conclusions

Given that socio-economically disadvantaged women are a population group at risk physical inactivity (Armstrong, Bauman, & Davies, 2000), sedentary behaviour (Clark et al., 2010) and depression (Scarinci et al., 2002), they are a particularly important target group for health research and promotion initiatives. Furthermore, considering a large number of studies indicate that physical inactivity is linked to an increased risk of depression (Teychenne, Ball, & Salmon, 2008b), there is a great need for evidence-based research to determine the most appropriate recommendations (i.e. the optimal dose, social context and domain of physical activity and sedentary behaviour), as well as feasible and
effective strategies to reduce the impact of the illness through the promotion of an active lifestyle.

Although increasing physical activity and reducing sedentary behaviour amongst socio-economically disadvantaged women with depressive symptoms poses a great challenge for health practitioners world-wide, this thesis provides evidence and insights into important components of physical activity and sedentary behaviour, as well as potential strategies, that could be considered when designing interventions targeted at socio-economically disadvantaged women, particularly those at risk of depression.
References


CARDIA. Coronary Artery Risk Development in Young Adults.

_Psychosomatic Medicine, 63_(4), 609-618.


capital and crime with physical activity amongst women. *Social Science and Medicine, 71*(4), 807-814.


Britton, J. A., Gammon, M. D., Kelsey, J. L., Brogan, D. J., Coates, R. J.,
Schoenberg, J. B., Potischman, N., Swanson, C. A., Stanford, J. L., and
exercise among women 20 to 44 years of age. Women and Health, 31(2-3),
81-96.

Racial/ethnic differences in the prevalence of depressive symptoms among
middle-aged women: The Study of Women's Health Across the Nation

and the treatment of clinical depression in adults. Sports Medicine, 32(12),
741-760.

Brown, D. R., Wang, Y., Ward, A., Ebbeling, C. A., Fortlage, L., Puleo, E.,
exercise and exercise plus cognitive strategies. Medicine and Science in
Sports and Exercise, 27(5), 765-775.

effects of a multi-modal intervention trial of light, exercise, and vitamins
on women's mood. Women and Health, 34(3), 93-112.

constraints and social support for active leisure among mothers with young
children. Leisure Sciences, 23, 131-144.


Measurement of physical activity: Reliability, comparison and validity of
self-report surveys: Summary and recommendations. Canberra:

Commonwealth Department of Aging.


Follow-up Study. *International Journal of Obesity and Related Metabolic Disorders*, 22(2), 89-96.


risk factor surveys: II. Design, methods, and estimates from combined state data. *American Journal of Preventive Medicine, 1*(6), 9-14.


Giles-Corti, B., and Donovan, R. (2002). Socioeconomic status differences in recreational physical activity levels and real and perceived access to a supportive physical environment. *Preventive Medicine, 35*(1), 601-611.


Lorant, V., Deliege, D., Eaton, W., Robert, A., Philippot, P., and Ansseau, M.


psycho-social characteristics of 18 year-old Australians. *Social Science and Medicine, 45*(10), 1549-1562.


Otten, J. J., Jones, K. E., Littenberg, B., and Harvey-Berino, J. (2009). Effects of television viewing reduction on energy intake and expenditure in
References

overweight and obese adults: a randomized controlled trial. *Archives of Internal Medicine, 169*(22), 2109-2115.


Pilu, A., Sorba, M., Hardoy, M. C., Floris, A. L., Mannu, F., Seruis, M. L.,
physical activity in the adjunctive treatment of major depressive disorders:
preliminary results. *Clinical Practice and Epidemiology in Mental Health*,
3, 8.

Mood and energy regulation in seasonal and non-seasonal depression
before and after midday treatment with physical exercise or bright light.
*Psychiatry Research*, 94(1), 29-42.

Epidemiology of leisure-time physical activity in socio-demographic,
lifestyle and psychological characteristics of men and women in Greece:

Efficacy of an E-mail intervention for the promotion of physical activity
and nutrition behavior in the workplace context. *American Journal of
Health Promotion*, 19(6), 422-429.

induced side effects: A practical guide for clinicians. *Journal of Clinical
Psychiatry*, 48, 3-8.

with obesity in South Asian, Afro-Caribbean and European women.
*International Journal of Obesity and Related Metabolic Disorders*, 23(1),
25-33.


questionnaire compared with interview to assess past-year physical activity. *Medicine and Science in Sports and Exercise, 32*(6), 1119-1124.


APPENDICES
Appendix 1

Sedentary behavior and depression among adults: A review (Published manuscript)
Sedentary Behavior and Depression Among Adults: A Review

Megan Teychenne - Kylie Ball - Jo Salmon

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Abstract
Background Physically inactive lifestyles and sedentary behaviors (SB) are key contributors to ill health. Although the association between SB (e.g., watching TV/using the computer) and physical health has been well documented, increasing research has focused on the possible link between SB and mental health (e.g., depression).

Purpose This review aims to investigate the effect of SB on the risk of depression in adults.

Method A systematic search for original research articles investigating associations between SB and depression in adults was performed using the several electronic databases.

Results A total of seven observational and four intervention studies were included in this review. All observational studies found positive associations between SB and risk of depression, while intervention studies showed contradictory results.

Conclusion Evidence for the relationship between SB and risk of depression in adults is limited by methodological weaknesses. However, on balance, this review suggests that SB is associated with an increased risk of depression. Further studies are needed assessing different types of SB and depression; the interrelationship between physical activity, SB, and depression; and causal links between SB and depression; and intervention strategies aimed at reducing SB and their effects on risk of depression.

Keywords Depression - Mental health - Television - Adult - Internet - Computers

Introduction
There is now good evidence that physical activity is associated with reduced risk of morbidity and/or mortality from a range of chronic conditions, such as type 2 diabetes [1–4], cardiovascular disease [5–8], obesity [9, 10], and various forms of cancer [11, 12]. However, a recent review has also suggested a beneficial effect of even low amounts of leisure-time physical activity on mental health outcomes, such as depression [13]. Clinical depression is a major cause of physical and psychosocial illness, as well as mortality [14], affecting nearly 6% of Australian adults [15]. In fact, an estimated 340 million people suffer from the disease worldwide [16]. Therefore, an understanding of impact of physical activity and conversely sedentary behaviors on the risk of depression may be an important avenue for developing intervention strategies to reduce the burden of disease associated with depressive illnesses.

Sedentary behavior may be defined as activity that is performed at or slightly above the resting metabolic rate (1–1.5 METS) [17] (e.g., equal to sitting or lying down) and encompasses a range of activities such as television viewing, computer use, playing video games, and passive recreation (e.g., sitting listening to music) [18, 19]. In developed countries, sedentary behavior has become increasingly prevalent [20], with television viewing found to be the most common leisure-time activity among adults in Australia [21], UK [22], and USA [23]. In fact, Australian adults spend approximately 2 h/day watching television [21], a level which is comparable to that of adults in other developed countries such as the USA [24]. In recent
studies, sedentary behavior, in particular, TV viewing, has been linked to increased risk of type 2 diabetes [25–27], obesity [26, 28], cardiovascular disease [29], high blood pressure [30], metabolic syndrome [31, 32], and abnormal glucose metabolism [27]. However, very little is known about the effects of sedentary behavior (e.g., TV viewing, computer use, and overall sitting time) on the risk of depression.

Numerous reviews of the literature have assessed the association between physical activity and risk of depression [13, 33–38]. Comparable conclusions were drawn from those reviews which indicated that physical activity is inversely associated with risk of depression in adults.

While there is emerging evidence in the area of sedentary behavior and the relationship with depression [39–42], no previous reviews have examined this literature to determine whether there are consistent associations between sedentary behaviors such as TV viewing or computer use and risk of depression. This literature review examines original research assessing the effects of sedentary behaviors on the risk of depression in adults. A particular focus will be on identifying the context/type of sedentary behavior most likely to impact on depression risk. It is hypothesized that higher levels of sedentary behavior will increase the risk of depression or depressive symptomatology.

Methods

Search Strategy

A systematic search for original research articles published post-1985 was conducted, as sedentary behavior, in particular, computer use, was found to increase significantly in developed countries after 1985 [43]. Electronic databases that were utilized for the literature search included: MEDLINE (via PubMed), Cinahl, PsychInfo, Science Direct, Google Scholar, and Expanded Academic. Included in the search were the following terms: sedentary behavior(s), TV/television viewing, sitting time, computer use, inactivity, depression, and mental health. Reference lists of relevant studies and reviews were further examined, as well as links to related articles within electronic databases.

Inclusion/Exclusion Criteria

Types of Studies

Both observational (i.e., cross-sectional, longitudinal) and intervention (randomized controlled trials (RCTs) and nonrandomized trials) studies were included in this literature review. Abstracts and dissertations were excluded.

Participants

Healthy adults (aged 18–60) of both genders are included in this review (i.e., those with no serious underlying medical conditions (excluding depression) that may confound statistical relationships).

Predictor and Outcome Measures

Studies in this review were required to include a valid indicator of risk of depression as well as at least one measure or indicator of sedentary behavior (i.e., any measure that assessed participant’s engagement in television viewing, computer and/or internet use, or overall sitting time).

Analyses of Published Studies

Studies identified were examined according to several methodological variables, including type of study (cross-sectional, longitudinal, intervention), sample (size, age), and the measures used (for assessing sedentary behavior and depression). Results were examined in terms of the statistical relationship (i.e., according to the p value) between sedentary behavior and risk of depression (see Tables 1 and 2). These are described below, categorized according to the type of sedentary behavior examined (i.e., overall sedentary time; combined TV/computer use; TV viewing; internet/computer use).

Methodological Quality Assessment

The quality of studies that were identified was systematically evaluated against a set of published criteria. The STROBE guidelines were used for assessing the quality of observational studies [44], and the CONSORT guidelines were used for assessing the quality of intervention studies [45]. For each of the 22 recommended criteria for both observational and intervention studies, a study scored 1 if they satisfied the criteria or zero if they did not. Studies were given a score for the quality of each section (i.e., Abstract, Introduction, Methods, Results, Discussion), as well as a score (out of 22) for the overall quality of the study, according to the appropriate checklist/guidelines [44, 45]. Consistent with the approach used in previous systematic reviews [46, 47], a quality score of 11/22 was used to define studies as high quality (see Tables 1 and 2).

Results

Approximately 1,200 citations were initially identified. After reviewing all abstracts, a total of 15 studies were
<table>
<thead>
<tr>
<th>Author/year</th>
<th>Sample &amp; study type</th>
<th>Relationship with depression</th>
<th>Depression measure</th>
<th>Sedentary behavior measure</th>
<th>Extra comments</th>
<th>Quality score (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ditmar (1994); USA [40]</td>
<td>48 college students (men and women), aged 18–24</td>
<td>+</td>
<td>MMPI</td>
<td>TV viewing: using a log (log how many hours/programs you watch on TV)</td>
<td>55</td>
<td></td>
</tr>
<tr>
<td>Kleinkne (1985); USA [51]</td>
<td>369 men and 389 women (college students, pain patients and veterans), aged 17–83</td>
<td>+</td>
<td>BDI and the Depression Coping Questionnaire</td>
<td>TV viewing: Depression Coping Questionnaire (Factor 10) &quot;I watch TV&quot;</td>
<td>23</td>
<td></td>
</tr>
<tr>
<td>Morgan et al. (2003); USA [42]</td>
<td>287 college &quot;freshmen&quot; (mean age 18)</td>
<td>+/-</td>
<td>CES-D</td>
<td>Internet usage: divided into use for communication and non-communication. Questionnaire asked for the number of hours per week participants spent using e-mail and chat rooms</td>
<td>E-mail hours was negatively associated with depression 77</td>
<td></td>
</tr>
<tr>
<td>Sanchez et al. (2008); USA [54]</td>
<td>394 overweight/obese women, aged 18–55</td>
<td>+</td>
<td>CES-D</td>
<td>Sedentary time: accelerometer</td>
<td>91</td>
<td></td>
</tr>
<tr>
<td>Sanchez-Villegas et al. (2008); Spain [41]</td>
<td>10,381 university graduates (mean age≈42)</td>
<td>+</td>
<td>Question: “Have you ever been diagnosed of depression by a health professional?” (Y/N)</td>
<td>TV/computer use (Sedentary Index): Question asking &quot;hours per week spent watching TV/computer use?&quot;</td>
<td>Joint association between (b/w) PA and SB on incidence of mental disorders. When PA is below median, SB below median, this indicates lower risk of mental disorder, while when PA above the median then SB not so crucial 86</td>
<td></td>
</tr>
<tr>
<td>Sidney et al. (1996); USA [52]</td>
<td>4,280 men and women, aged 23–35</td>
<td>+</td>
<td>CES-D</td>
<td>TV viewing (Questionnaire): “During LT, how many hours per day do you watch TV?”</td>
<td>64</td>
<td></td>
</tr>
<tr>
<td>Thomee et al. (2007); Sweden [39]</td>
<td>1,127 younger adults (men and women), aged 18–25</td>
<td>+</td>
<td>The psychiatric Prime-MD screening form (2 items)</td>
<td>Computer/internet: Questionnaire asking how much time in the past 7 days have participants used computers, surfed the Internet, chatted online, e-mailed (also mobile phone use—N/A)</td>
<td>For the group, high ICT use (includes mobile phone use) associated with both items of depression 86</td>
<td></td>
</tr>
</tbody>
</table>

_CES-D Center for Epidemiologic Scale for Depression, BDI Beck Depression Inventory, MMPI Minnesota Multiphasic Personality Inventory_
Table 2: Intervention studies of sedentary behavior and depression in adults

<table>
<thead>
<tr>
<th>Author/year</th>
<th>Sample &amp; study type</th>
<th>Relationship with depression</th>
<th>Depression measure</th>
<th>Sedentary behavior measure</th>
<th>Quality score (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kravit et al. (1998); USA [53]</td>
<td>256 men and women (from 93 families), aged 10+ intervention</td>
<td>+</td>
<td>CES-D</td>
<td>Internet usage: software recorded total hours per week that the participant connected to internet aged 10+</td>
<td>68</td>
</tr>
<tr>
<td>Kravit et al. (2002); USA (study 1) [48]</td>
<td>208 men and women, aged 10+ intervention</td>
<td>-</td>
<td>CES-D</td>
<td>Internet usage: software recorded total hours per week that the participant connected to internet</td>
<td>41</td>
</tr>
<tr>
<td>Kravit et al. (2002); USA (study 2) [48]</td>
<td>406 men and women, aged 10+ RCT</td>
<td>0</td>
<td>CES-D</td>
<td>Internet/computer usage: questionnaire asking how often participants use the internet/e-mail/computer</td>
<td>55</td>
</tr>
<tr>
<td>Shaw et al. (2002); USA [55]</td>
<td>40 undergraduate students (age NA) Intervention study/ randomized trial</td>
<td>-</td>
<td>CES-D</td>
<td>Computer/internet: 5 Internet/chat sessions were scheduled (b/w 2 participants), and face-to-face interviews with the experimenter were carried out</td>
<td>50</td>
</tr>
</tbody>
</table>

CES-D Center for Epidemiologic Scale for Depression, RCT randomized controlled trial

found to be potentially eligible for inclusion. The high number of studies identified initially was due to the numerous search terms used in order to cover all types of sedentary behavior. However, most did not meet the requirements/purpose of this review. Following a screening of full papers according to the selection criteria, four papers were excluded as all four of those papers did not include a valid indicator of depression. Therefore, a total of seven observational (five cross-sectional, two longitudinal) and four intervention (two RCTs, two noncontrolled trials) studies were included in this review, with one paper [48] presenting two separate studies within it. Methods and results of these studies are summarized in Tables 1 and 2.

Participants in the studies were “healthy” nonclinically depressed adults, predominantly from the USA. Risk of depression was assessed using validated measures such as the Beck Depression Inventory [49] and the Center for Epidemiologic Studies Depression Scale [50]. Sedentary behavior was measured using various methods. For example, TV viewing was measured using time-use logs [40] and questionnaires [51, 52]; computer/internet use was measured using computer software [48, 53] and questionnaires [39, 42]; overall sedentary behavior (i.e., sitting and lying time) was measured using a “Sedentary Index” [41], as well as by more direct measures such as accelerometers [54]. These measures are described in further detail in Tables 1 and 2. Only one study reported on the validity and reliability of the measures used to assess sedentary behavior [54].

Of the 11 studies, seven (six observational and one intervention) found a positive association between sedentary behaviors and risk of depression [39–41, 51–54]. A total of two intervention studies found an inverse association between sedentary behavior and risk of depression (i.e., the greater time spent in sedentary behavior, the lower the odds of depressive symptoms) [48, 55]. One cross-sectional study found both positive and negative associations between sedentary behavior and risk of depression [42], while one intervention study found no association between the two variables [48].

Methodological Quality Assessment

The quality score of studies included in this review ranged from 23% to 91%. Of the observational studies, six of the seven received a STROBE [44] score greater than 50% and were therefore considered to be of high methodological quality [39–42, 52, 54]. Essential information regarding the methodological quality of the study was missing in all observational studies. Although all observational studies were able to give sources of data and details of methods of assessment, only four of those described efforts to address potential sources of bias [39, 41, 52, 54]. The majority of observational studies did not provide sufficient information on participants (either demographic information or reasons for nonparticipation) to achieve a perfect score in that criteria [40, 41, 51, 52]; however, four of the seven observational studies did discuss limitations of their designs [39, 41, 42, 54].

Of the intervention studies, two of the four were considered to be of high methodological quality (CONSORT [45] score greater than 11/22) [48, 53]. Essential information regarding the methodological quality of the study was missing in all intervention studies, in particular, information on the methods used to generate and implement the random allocation concealment, as well as blinding of
participants in interventions. Although the flow of participants in each stage was described in all intervention studies, only two described the dates of recruitment and/or follow-up [48, 53]. A general interpretation of results in the context of current evidence was given for each study; however, two studies did not take into account study hypotheses and/or sources of potential bias [48, 53].

**Main Findings**

**Overall Sedentary Time**

One cross-sectional study assessed the relationship between "overall" sedentary time (e.g., time spent sitting and lying) and risk of depression [54]. Sanchez et al. [54] used accelerometers to measure time spent sedentary in 394 overweight/obese women. Daily hours of sedentary behavior were defined by summing the minutes spent at less than 100 counts per minute for valid hours of monitoring (i.e., when awake). The study found that those who reported greater amounts of overall sedentary time had higher odds of depressive symptoms.

**Combined TV Viewing and Computer Use**

One longitudinal study examined the relationship between combined self-reported TV viewing and computer use and risk of a mental disorder such as depression [41]. A total of 74% of participants suffered from depression in that study. That study found that participants with the highest levels of sedentary habits at baseline (>42 h week⁻¹) were 31% more likely to be at risk of a mental disorder (depression, bipolar, anxiety, or stress) at follow-up than those who reported low levels of sedentary behavior at baseline (<10 h week⁻¹). Interestingly, that study also included a measure of physical activity and found an interaction between sedentary behavior, physical activity, and risk of a mental disorder. It showed that if physical activity was below the median (<13.8 MET h week⁻¹), a sedentary lifestyle was associated with an increased risk of a mental disorder. However, when physical activity was above the median, sedentary behavior was not as strongly associated with risk of a mental disorder.

**TV Viewing**

Three cross-sectional studies assessed the relationship between self-reported TV viewing and depression. Dittmar et al. [40] and Sidney et al. [52] both used measures which assessed the hours spent watching TV, while Kleinke et al. [51] included one question only determining whether the participant watches TV (yes/no). All three studies found that TV viewing was positively associated with risk of depression.

**Internet/Computer Use**

Thomee et al. [39] longitudinally assessed the individual components of information and communications technology including time spent using computers, surfing the internet, chatting online, and e-mailing. That study found that time spent e-mailing and chatting online predicted increased risk of depression at the 1-year follow-up in women (but not in men). However, no relationship was found between overall computer or internet use and risk of depression.

Similarly, an intervention study conducted by Kraut et al. [53] also assessed the relationship between hours spent using the internet (using internet usage software) and risk of depression in a sample of families who were provided with a free computer and internet use. That study found that overall internet use was associated with an increased risk of depression.

Two intervention studies identified in this review found a negative association between sedentary behavior and risk of depression [48, 55], reporting that greater time spent in sedentary behavior was related to lower odds of depression. Kraut et al. [48] conducted an intervention study which assessed the relationship between internet use and depression in a sample of families who were provided with a computer and free internet access. They found that depressive symptoms increased within the first period of assessment, then over time significantly decreased with internet/computer use, implying that time spent on the internet may actually be beneficial in reducing the risk of depression over time.

The randomized trial conducted by Shaw et al. [55] assessed the effects on depression of an internet “chatting” intervention which prescribed five “chat” sessions between participants. That study found that internet “chatting” led to a reduction in depressive symptoms. Furthermore, the study found that internet use reduced loneliness and increased social support, suggesting an underlying mechanism in the relationship between internet use and depression. Similarly, one cross-sectional study that assessed the association between internet use for various purposes and risk of depression in college freshman found both positive and negative associations between internet use and risk of depression [42]. Although both chat room and e-mail hours were associated with lower risk of depression, time spent “surfing” the internet (e.g., using the internet for games, shopping, and research) was associated with greater risk of depression.

One RCT, which recruited participants (aged 10+) from households that had recently brought a new computer or
television, examined sedentary behavior in terms of hours spent on the internet, e-mail and using the computer in general [48]. Those in the intervention were offered free internet for 12 months to encourage internet and computer usage, with the control group being offered an equivalent amount of money to participate. Recent television purchasers were considered as a comparison group as they were less likely to use the internet. The intervention group showed no change in the risk of depression relative to the comparison group in this study [48].

Discussion

This review is the first to consider the evidence for the effect of sedentary behavior on risk of depression. The majority of studies identified used cross-sectional or longitudinal observational designs, and hence, while the available evidence is suggestive of associations between sedentary behavior and risk of depression, there is much less evidence of the effects of sedentary behavior on risk of depression. The majority of studies (seven out of 11) found a positive association between higher levels of sedentary behavior and experiencing depressive symptoms. Interestingly, all four studies that found either an inverse association or no association between sedentary behavior and risk of depression included internet/computer use as a measure of sedentary behavior [42, 48, 55]. While the direction and causality of these associations require further investigation, this finding suggests that perhaps the type or purpose of sedentary behavior may be a defining factor in the relationship with depression. For example, time spent sitting at a computer for online chatting (socially) may not be as important a risk factor for depression as time spent watching television. Conversely, it may be that those not at risk of depression engage in more social sedentary behaviors. However, studies assessing television viewing for example did not differentiate whether participants were viewing television on their own or with family and friends. Further, all four of the studies that found either an inverse association or no association between sedentary behavior and risk of depression were hampered by methodological limitations which may have influenced results. For example, the age range of participants in the study by Kraut et al. [48] was large and nonspecific (e.g., over 10 years of age). As adults and children have different purposes for using computers (e.g., children may use computers to play games and chat to friends, while adults may use computers for work, e-mails, banking, or shopping), a target group with a narrower age range may have resulted in the detection of significant associations between computer/internet use and risk of depression. Furthermore, in that study, the control group condition failed as by the end of the intervention, 83% of control households gained internet access on their own (compared to 95% of the experimental households). Due to this, analyses were undertaken by combining the groups.

Longitudinal and intervention studies are methodologically stronger than cross-sectional studies, and hence, greater weight might be given to the findings of these studies. Both longitudinal studies included in this review found a positive association between sedentary behavior and risk of depression [39, 41]. Those studies were of high methodological quality according to published criteria [44]. Those studies assessed risk of depression over time, and results suggested that spending longer hours in sedentary activities, such as sitting at the computer, may lead to an increased risk of mental disorders, in particular, depression. Alternatively, since causality could not be directly inferred, it may be that those experiencing depressive symptoms spend more time engaged in sedentary behaviors. Of the four intervention studies included in this review, only one found positive effects of sedentary behavior (internet use) on risk of depression [53], with two other intervention studies finding negative effects of sedentary behavior (computer/internet use) on risk of depression [48, 55]. Those two studies, however, were of low methodological quality according to published criteria [45]. Although the findings of those latter two studies suggest that time spent using the internet reduces the risk of depression, those studies only assessed internet use (rather than total time spent sitting at the computer). As the internet may be used for purposes such as communication and social networking, further intervention studies are needed to assess the relationship between total time spent sitting at the computer (i.e., for internet use and other purposes), in addition to specific computer-based activities, and risk of depression.

Our previous review on the association between physical activity and risk of depression suggested that there is good evidence of the role of physical activity (e.g., walking, and moderate and vigorous intensity) in reducing the risk of depression in adults [13]. However, that review did not consider the effects of sedentary behavior (e.g., sitting, watching television) on risk of depression. An interesting finding to emerge in the present review was the possible existence of an interaction between sedentary behavior, physical activity, and depression. Just one study assessed whether the relationship between sedentary behavior and depression may be influenced by physical activity [41]. That study found sedentary behavior to be an important correlate of reduced risk of depression when physical activity levels were low, yet it was not a critical aspect when physical activity levels were high, suggesting that physical activity might attenuate the association between sedentary behavior and depression. However, a limitation of that study was that depression was not reported.
exclusively as the outcome measure (e.g., the outcome measure [mental disorder] combined depression, stress, and anxiety). Since no other previous studies have assessed the relationship between sedentary behavior, physical activity, and risk of depression, this highlights an important point of consideration for further research. It may be that having a low sedentary lifestyle plays an important role in reducing the risk of depression only when moderate–vigorous physical activity levels are also low.

There has been little research into the underlying mechanisms explaining the positive association between sedentary behavior and risk of depression. The social withdrawal hypothesis is one mechanism that has been suggested to explain the association between increasing sedentary behavior and increasing risk of depression [53, 56]. This hypothesis proposes that the more frequently people watch TV or use the computer/internet, the further they remove themselves from social interaction, which in turn increases their risk of depression [53, 56]. However, as the internet is most often regarded as a social technology used for communication (e.g., chat rooms and e-mailing), this hypothesis may not be applicable to all sedentary behaviors. For example, one intervention study that included internet “chatting” [55] as a measure of sedentary behavior showed that using the internet/computer decreased the risk of depression. As that intervention was designed to increase communication and socialization, it may be that the purpose and content of sedentary activities, rather than the time spent undertaking them, have the greatest impact on the risk of depression. For instance, if the intervention had involved surfing the internet for educational or work-related purposes, results may have been different. Further, social support in general is independently linked to a decreased risk of depression [57]; and therefore, social support may have been the underlying mechanism for the reduction in depressive symptoms in that study. However, as results of several studies were conflicting (e.g., finding positive and negative relationships between computer/internet use and risk of depression [39, 42, 55]), other physiological or psychological mechanisms may be considered to explain the association between sedentary behavior and risk of depression.

Another possible explanation for the positive relationship between sedentary behavior and risk of depression is that sedentary behavior may actually displace physical activity, which has been found to be beneficial in reducing the risk of depression in adults [13]. Several studies have found an inverse association between sedentary behavior (e.g., TV viewing) and physical activity [58, 59], suggesting that the more time adults spend engaging in sedentary behaviors, the less time they will spend being physically active. This highlights the need for further longitudinal and intervention studies testing this hypothesis.

Study Limitations

Several studies included in this review were limited by methodological weaknesses, which include small sample sizes [40] and crude/insensitive measures of sedentary behavior [51]. For example, Kleinke et al. [51] included just one question determining whether the participant watches TV (yes/no). Further, most studies included self-report measures (e.g., questionnaires) of sedentary behavior and risk of depression which can be limited by recall difficulties, socially desirable answers, and error in judgment. Generally, self-report measures also neglected to determine whether participants were being active/standing up while concurrently engaging in activities classified as “sedentary behaviors” such as television viewing or computer use (e.g., watching TV while working out or playing active “new generation” computer games). Therefore, most studies could only assume that participants were being sedentary for the time reported. Nevertheless, recent research has suggested that although playing “new generation” computer games (e.g., Nintendo Wii sports games) expends more energy than playing sedentary computer games, the energy used is not high enough to contribute toward the daily recommended dose of physical activity in children and adolescents [60]. Finally, as the majority of studies that assessed the association between sedentary behavior and risk of depression were cross-sectional, causality and direction of relationships could not be determined. For example, it is not known whether time spent in sedentary behavior increases the risk of depression or whether those experiencing depressive symptoms tend to spend greater amounts of time engaged in sedentary behaviors as a consequence of their depression. Although this review has described the quality of each study according to appropriate checklists/guidelines [44, 45], it must be acknowledged that those guidelines do not take into account weightings of different criteria points, which may limit the interpretation of the overall quality score.

Conclusion

When evaluated against published guidelines [44, 45], it may be concluded that the available evidence for the effects of sedentary behavior on risk of depression in adults is limited by methodological weaknesses. While the findings of this review are not unequivocal, on the whole they are suggestive of a positive association between sedentary behaviors and risk of depression. However, the causality and mechanisms linking sedentary behavior and depression require further investigation. No interventions have been designed to reduce sedentary behavior and examine the associated effects on risk of depression. This review
highlights existing research gaps, with further studies needed to examine the associations of different types of sedentary behaviors with risk of depression; the possible interrelationship between physical activity, sedentary behavior, and risk of depression; and the temporal relationship between sedentary behaviors and risk of depression. There is also a need for research identifying intervention strategies aimed at reducing sedentary behavior and their effects on risk of depression.

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References

Appendix 2

Literature review tables
<table>
<thead>
<tr>
<th>Author/year/country</th>
<th>Sample &amp; study type</th>
<th>Measures</th>
<th>Domain</th>
<th>Social context</th>
<th>Relationship with depression</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Adams et al (2007); US</td>
<td>22,073 college females, mean age = 18</td>
<td>Depression: Dichotomous depression question</td>
<td>LTPA</td>
<td>NA</td>
<td>-</td>
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<tr>
<td></td>
<td>Cross-sectional</td>
<td>PA: Participants reported the frequency of vigorous PA in past seven days,</td>
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<tr>
<td>2 Allgöwer et al (2001); UK</td>
<td>3,438 female university students, aged 18-30</td>
<td>Depression: BDI</td>
<td>LTPA</td>
<td>NA</td>
<td>-</td>
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<tr>
<td></td>
<td>Cross-sectional</td>
<td>PA: “Have you exercise ≥5 times in the past two weeks?”</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>3 Asztalos et al (2010); Belgium</td>
<td>6803 adults, aged 25-64</td>
<td>Depression: GHQ-12</td>
<td>NA</td>
<td>NA</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Cross-sectional</td>
<td>PA: IPAQ (short form)</td>
<td></td>
<td></td>
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<tr>
<td>4 Ball et al (2009); Australia</td>
<td>6,677 young women, aged 22-27</td>
<td>Depression: CES-D-10</td>
<td>LTPA + transport</td>
<td>NA</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>Longitudinal</td>
<td>PA: Valid and reliable PA measure used to assess frequency and duration of walking, moderate- and vigorous-intensity PA</td>
<td></td>
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<tr>
<td>5 Bhui et al (2000); UK</td>
<td>5352 adults, aged 18+</td>
<td>Depression: GHQ-30</td>
<td>Combined LTPA &amp; domestic</td>
<td>NA</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Longitudinal</td>
<td>PA: Question- “How many times per week do you take part in the following activities? (List)”</td>
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<tr>
<td>Author/year/country</td>
<td>Sample &amp; study type</td>
<td>Measures</td>
<td>Domain</td>
<td>Social context</td>
<td>Relationship with depression</td>
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<tr>
<td>6 Brown et al (2000); Australia</td>
<td>39,532 women, aged 18-75 Cross-sectional</td>
<td>Depression: SF-36-Medical outcomes study’s functioning and well-being profile PA: Questions from the Australian National Heart Foundation’s Risk Factor Prevalence study</td>
<td>Combined LTPA &amp; domestic</td>
<td>NA</td>
<td>-</td>
</tr>
<tr>
<td>7 Brown et al (2005); Australia</td>
<td>9,207 women, aged 45-50 Longitudinal</td>
<td>Depression: CES-D PA: “How many times in a normal week do you engage in vigorous exercise or less vigorous exercise?”</td>
<td>LTPA</td>
<td>NA</td>
<td>-</td>
</tr>
<tr>
<td>8 Camacho et al (1991); US</td>
<td>5,000 men and women, aged 20+ Longitudinal</td>
<td>Depression and PA measures were both valid (although not stated) PA: “How often do you do these things? (list of activities)”</td>
<td>Combined LTPA &amp; domestic</td>
<td>NA</td>
<td>(‘low levels’)</td>
</tr>
<tr>
<td>9 Carroll et al (2010); US</td>
<td>5,389 adults, aged 51-61 Longitudinal</td>
<td>Depression: CES-D 8 PA: One question “…over the past 12 months have you participated in vigorous PA or exercise 3 times a week or more?”</td>
<td>Combined LTPA, transport, domestic &amp; work PA</td>
<td>NA</td>
<td>-</td>
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<tr>
<td>Author/year/country</td>
<td>Sample &amp; study type</td>
<td>Measures</td>
<td>Domain</td>
<td>Social context</td>
<td>Relationship with depression</td>
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<tr>
<td>De Moor et al (2008); Netherlands</td>
<td>5952 twins, 1357 additional siblings, 1249 parents, aged 18-50 years Longitudinal</td>
<td>Depression: Young adult self report depression sale (YASR), PA: Type, frequency and duration of PA were all assessed</td>
<td>LTPA</td>
<td>Social support (from family)</td>
<td>0</td>
</tr>
<tr>
<td>Farmer et al (1988); US</td>
<td>1,900 healthy adults, aged 25-77 Longitudinal</td>
<td>Depression: CES-D, PA: 2 questions - Validity not determined</td>
<td>LTPA</td>
<td>NA</td>
<td>* ('white women')</td>
</tr>
<tr>
<td>France et al (2004); Australia</td>
<td>9,333 women, aged 22-27 Cross-sectional</td>
<td>Depression: CES-D-10, PA: Unspecified measure (daily PA)</td>
<td>LTPA</td>
<td>NA</td>
<td>-</td>
</tr>
<tr>
<td>Galper et al (2006); US</td>
<td>6728 adults, aged 20-88 Cross-sectional</td>
<td>Depression: CES-D 20, PA: Physical Activity Index</td>
<td>LTPA</td>
<td>NA</td>
<td>-</td>
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<tr>
<td>Author/year/country</td>
<td>Sample &amp; study type</td>
<td>Measures</td>
<td>Domain</td>
<td>Social context</td>
<td>Relationship with depression</td>
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<tr>
<td>15 Harbour et al (2008); US</td>
<td>8621 college students, mean age = 21. Cross-sectional</td>
<td>Depression: One single question ('Down hearted and blue')</td>
<td>NA</td>
<td>NA</td>
<td>-</td>
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<tr>
<td></td>
<td></td>
<td>PA: One validated question</td>
<td></td>
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<tr>
<td>16 Juarbe et al (2006); US</td>
<td>81 Latina women and 151 white women, aged 40-50 years Longitudinal</td>
<td>Depression: CES-D-20</td>
<td>LTPA</td>
<td>NA</td>
<td>0</td>
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<tr>
<td></td>
<td></td>
<td>PA: Paffenbarger Activity Questionnaire (PAQ)</td>
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<tr>
<td>17 Kritz-Silverstein et al (2001); US</td>
<td>1,180 middle classed men and women, aged 50-89 Cross-sectional &amp; Longitudinal</td>
<td>Depression: BDI</td>
<td>NA</td>
<td>NA</td>
<td>- (Cross-sectional only)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>PA: Assessed strenuous exercise – Indirectly validated</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>18 Kull (2002); Estonia</td>
<td>659 women, aged 18-45 Cross-sectional</td>
<td>Depression: GHQ-40 and BDI</td>
<td>NA</td>
<td>NA</td>
<td>-</td>
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<tr>
<td></td>
<td></td>
<td>PA: “How much of your weekly LT have you participated in PA which involved sweating and breathlessness in the past year?”</td>
<td></td>
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<tr>
<td>19 Lee et al (2008); Korea</td>
<td>648 middle-aged women, aged 40-60 Cross-sectional</td>
<td>Depression: Beck Depression Inventory</td>
<td>LTPA</td>
<td>NA</td>
<td>-</td>
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<tr>
<td></td>
<td></td>
<td>PA: “Did you participate in regular physical activity ≥30 mins at a time in the past 6 months?”</td>
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<tr>
<td>Author/year/country</td>
<td>Sample &amp; study type</td>
<td>Measures</td>
<td>Domain</td>
<td>Social context</td>
<td>Relationship with depression</td>
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<tr>
<td>Mikkelsen et al (2010); Denmark</td>
<td>18,146 adults, aged 20-93 Longitudinal</td>
<td>Depression: ICD (International Classification of Diseases – WHO)</td>
<td>LTPA/transport PA</td>
<td>NA</td>
<td>-</td>
</tr>
<tr>
<td>Mutrie et al (2007); UK</td>
<td>1,742 men and women, aged 24, 44 and 64 Cross-sectional</td>
<td>Depression: Hospital Anxiety and Depression Scale (HADS)</td>
<td>Work PA</td>
<td>NA</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td></td>
<td>PA: Weekly occasions of moderate or vigorous PA (at home, work, leisure, overall)</td>
<td>Home PA</td>
<td>NA</td>
<td>+</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Overall (work/home/LTPA)</td>
<td>LTPA</td>
<td>NA</td>
<td>-</td>
</tr>
<tr>
<td>McKercher et al (2009) Australia</td>
<td>1,995 men and women, aged 26-36 Cross-sectional</td>
<td>Depression: Composite International Diagnostic Interview (CIDI Auto)</td>
<td>LTPA</td>
<td>NA</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td></td>
<td>PA: IPAQ</td>
<td>Work PA</td>
<td>NA</td>
<td>+</td>
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<tr>
<td></td>
<td></td>
<td>Total PA (steps)</td>
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<td></td>
<td></td>
<td>Transport PA</td>
<td></td>
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<td></td>
<td></td>
<td>Domestics PA</td>
<td></td>
<td></td>
<td>0</td>
</tr>
<tr>
<td>Milligan et al (1999); Australia</td>
<td>282 females, aged 19. Cross-sectional</td>
<td>Depression: Zung depression Scale</td>
<td>NA</td>
<td>NA</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td></td>
<td>PA: Participants rated PA as “very active/active/moderately active/low active/not active”</td>
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</tbody>
</table>
Table A.2.1 (Continued) Physical activity and depression in women (Observational studies)

<table>
<thead>
<tr>
<th>Author/year/country</th>
<th>Sample &amp; study type</th>
<th>Measures</th>
<th>Domain</th>
<th>Social context</th>
<th>Relationship with depression</th>
</tr>
</thead>
<tbody>
<tr>
<td>24 Oman &amp; Oman (2003); US</td>
<td>94 white women, mean age 44. Case-control study</td>
<td>Depression: CES-D PA: Categorical value ranging from 'no experience' to '6 or more years experience'</td>
<td>LTPA</td>
<td>NA</td>
<td>0</td>
</tr>
<tr>
<td>25 Pitsavos et al (2005); Greece</td>
<td>1528 women (and 1514 men), aged 20-89. Cross-sectional</td>
<td>Depression: Zung-Self Rating Scale PA: ‘Validated PA measure’</td>
<td>LTPA</td>
<td>NA</td>
<td>-</td>
</tr>
<tr>
<td>26 Rajala et al (1994); Finland</td>
<td>345 men and 435 women, aged 55. Cross-sectional</td>
<td>Depression: Zung Self-Rating Depression Scale PA: Question assessing how much exercise one does in LT and going to and from work.</td>
<td>LTPA &amp; Transport (to and from work)</td>
<td>NA</td>
<td>0</td>
</tr>
<tr>
<td>27 Stephens (1988); Canada</td>
<td>55, 979 individuals aged 10+ Cross-sectional</td>
<td>Depression: CES-D 18 and Health Opinion Survey PA: Validity not determined</td>
<td>Combined LTPA &amp; domestic</td>
<td>NA</td>
<td>-</td>
</tr>
<tr>
<td>28 Steptoe (1997); UK</td>
<td>9,181 female (and 7,302 male), aged 18-30 years, Cross-sectional</td>
<td>Depression: BDI PA: Question assessing frequency and type of exercise undertaken in past 2 weeks</td>
<td>NA</td>
<td>NA</td>
<td>Social Support</td>
</tr>
<tr>
<td>Author/year/country</td>
<td>Sample &amp; study type</td>
<td>Measures</td>
<td>Domain</td>
<td>Social context</td>
<td>Relationship with depression</td>
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<tr>
<td>29  Taliaferro et al (2009); US</td>
<td>43,499 college students, aged 18-25</td>
<td>Depression: “How many times in the past year did you feel so depressed it was difficult to function?”</td>
<td>LTPA</td>
<td>NA</td>
<td>-</td>
</tr>
<tr>
<td>30  Teychenne et al, (2008); Australia</td>
<td>1,501 women, aged 18-65 years, Cross-sectional</td>
<td>Depression: GHQ-30, PA: International Physical Activity Questionnaire (IPAQ-L)</td>
<td>LTPA</td>
<td>NA</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td></td>
<td>PA: Frequency of moderate and vigorous PA</td>
<td>Work PA</td>
<td>NA</td>
<td>0</td>
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<td></td>
<td></td>
<td></td>
<td>Transport PA</td>
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<td>0</td>
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<td>Domestic PA</td>
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<td>NA</td>
<td>Discouraged from PA</td>
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<td></td>
<td>NA</td>
<td>No one to exercise with</td>
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<td></td>
<td></td>
<td>NA</td>
<td>Member of sports club</td>
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<td></td>
<td></td>
<td></td>
<td>NA</td>
<td>Active with family member</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>NA</td>
<td>Active with friend</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>NA</td>
<td>Have someone to walk with in neighbourhood</td>
<td>0</td>
</tr>
</tbody>
</table>
Table A.2.1 (Continued) Physical activity and depression in women (Observational studies)

<table>
<thead>
<tr>
<th>Author/year/country</th>
<th>Sample &amp; study type</th>
<th>Measures</th>
<th>Domain</th>
<th>Social context</th>
<th>Relationship with depression</th>
</tr>
</thead>
<tbody>
<tr>
<td>31 Weyerer (1992); Germany</td>
<td>1,536 men and women, aged 15+ Cross-sectional &amp; Longitudinal</td>
<td>Depression: International Classification of Diseases (ICD)</td>
<td>LTPA</td>
<td>NA</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td></td>
<td>PA: “How often do you currently exercise for sports (never/occasionally/regularly)”</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>32 Wise et al (2006); US</td>
<td>35,224 African-American women, aged 21-69 Longitudinal</td>
<td>Depression: CES-D</td>
<td>LTPA</td>
<td>NA</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td></td>
<td>PA: Valid measure assessing walking and vigorous PA duration in past week</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>33 Wyshak (2001); US</td>
<td>3940 female college alumnae, aged &lt;45 to &gt;75 Longitudinal/retrospective</td>
<td>Depression: Rand Mental Health Inventory (RMHI-5)</td>
<td>LTPA</td>
<td>NA</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td></td>
<td>PA: Questions assessing the duration, frequency and type of PA undertaken per week</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

PA, Physical activity; LTPA, Leisure-time physical activity; BDI, Beck Depression Inventory; CES-D, Centre for Epidemiologic Studies Depression Scale; GHQ, General Health Questionnaire; IPAQ, International Physical Activity Questionnaire

0 = N/S
- = Significant inverse association between PA and depression
+ = Significant linear association between PA and depression
NA = Not assessed
<table>
<thead>
<tr>
<th></th>
<th>Author/year</th>
<th>Sample &amp; study type</th>
<th>Measures</th>
<th>Domain</th>
<th>Social context</th>
<th>Relationship with depression</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Anderson et al (1999); US</td>
<td>40 obese, sedentary women, aged 21-60 RCT</td>
<td>Depression: BDI</td>
<td>LTPA</td>
<td>Accompanied (exercise class)</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Lifestyle PA: (transport/occupational/domestic)</td>
<td>NA</td>
</tr>
<tr>
<td>2</td>
<td>Ansbury et al (2006); UK</td>
<td>23 healthy post-menopausal women (mean age = 56) RCT</td>
<td>Depression: Hospital and Anxiety Depression Scale (HADS)</td>
<td>LTPA</td>
<td>NA</td>
<td>-</td>
</tr>
<tr>
<td>3</td>
<td>Balkin et al (2007); US</td>
<td>110 young adult women, mean age = 21 RCT</td>
<td>Depression: BDI II</td>
<td>LTPA</td>
<td>Accompanied</td>
<td>-</td>
</tr>
<tr>
<td>4</td>
<td>Berger et al (1992); US</td>
<td>87 college students, mean ages = 28, 20 &amp; 21 RCT</td>
<td>Depression: POMS</td>
<td>LTPA</td>
<td>Accompanied</td>
<td>-</td>
</tr>
<tr>
<td>5</td>
<td>Brown et al (1995); US</td>
<td>135 healthy sedentary adults, aged 40-60 RCT</td>
<td>Depression: POMS</td>
<td>LTPA</td>
<td>Accompanied</td>
<td>-</td>
</tr>
</tbody>
</table>
Table A.2.2 (Continued)  Physical activity and depression in women (Intervention studies)

<table>
<thead>
<tr>
<th>Author/year</th>
<th>Sample &amp; study type</th>
<th>Measures</th>
<th>Domain</th>
<th>Social context</th>
<th>Relationship with depression</th>
</tr>
</thead>
<tbody>
<tr>
<td>6 Brown et al (2001); US</td>
<td>112 women with mild-moderate depressive symptoms, aged 19-78</td>
<td>Depression: CES-D, POMS</td>
<td>LTPA</td>
<td>Individual (‘Coach’- brief phone call every 2 weeks)</td>
<td>-</td>
</tr>
<tr>
<td>7 Craft et al (2007); US</td>
<td>32 women with depressive symptoms, aged 18-55</td>
<td>Depression: BDI</td>
<td>LTPA</td>
<td>Individual (home-based)</td>
<td>-</td>
</tr>
<tr>
<td>8 Cramer et al (1991); US</td>
<td>35 mildly obese women, aged 25-45</td>
<td>Depression: GWB (General Well-Being Schedule) and POMS</td>
<td>LTPA</td>
<td>Accompanied (Clinic-based, with supervisor)</td>
<td>-</td>
</tr>
<tr>
<td>9 Doyne et al (1987); US</td>
<td>40 women with clinical depression, aged 18-35</td>
<td>Depression: BDI and Hospital and Anxiety Depression Scale (HADS)</td>
<td>LTPA</td>
<td>Individual (although supervised)</td>
<td>-</td>
</tr>
<tr>
<td>10 King et al (1989); US</td>
<td>120 sedentary adults, mean age (females) = 49</td>
<td>Depression: BDI</td>
<td>LTPA</td>
<td>Individual (home-based, supervised program)</td>
<td>0</td>
</tr>
<tr>
<td>Author/year</td>
<td>Sample &amp; study type</td>
<td>Measures</td>
<td>Domain</td>
<td>Social context</td>
<td>Relationship with depression</td>
</tr>
<tr>
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</tr>
<tr>
<td>King et al (1993); US</td>
<td>357 healthy men and women, aged 50-65 (RCT)</td>
<td>Depression: BDI and RPC</td>
<td>LTPA</td>
<td>Individual (home-based) (BDI)</td>
<td>0</td>
</tr>
<tr>
<td>Lee et al (2001); US</td>
<td>102 ethnic minority women, aged 25-55 (RCT (Behavioural based))</td>
<td>Depression: POMS</td>
<td>LTPA</td>
<td>NA</td>
<td>0</td>
</tr>
<tr>
<td>Nabkasorn et al (2006); Thailand</td>
<td>49 females with mild-moderate depressive symptoms, aged 18-20 (RCT)</td>
<td>Depression: CES-D</td>
<td>LTPA</td>
<td>Accompanied</td>
<td>-</td>
</tr>
<tr>
<td>Nieman et al (2000); US</td>
<td>30 obese women, aged 25-70 (RCT)</td>
<td>Depression: POMS and the General Well-Being Schedule</td>
<td>LTPA</td>
<td>NA (Supervised)</td>
<td>0</td>
</tr>
<tr>
<td>Norvell et al (1991); US</td>
<td>43 sedentary women, mean age = 58 (RCT)</td>
<td>Depression: Mental Health Inventory</td>
<td>LTPA</td>
<td>NA (Supervised)</td>
<td>0</td>
</tr>
</tbody>
</table>
Table A.2.2 (Continued) Physical activity and depression in women (Intervention studies)

<table>
<thead>
<tr>
<th>Author/year</th>
<th>Sample &amp; study type</th>
<th>Measures</th>
<th>Domain</th>
<th>Social context</th>
<th>Relationship with depression</th>
</tr>
</thead>
<tbody>
<tr>
<td>16 Palmer (1995); US</td>
<td>27 female volunteers, aged 29-50</td>
<td>Depression: CES-D</td>
<td>LTPA</td>
<td>Accompanied (with supervisor)</td>
<td>0</td>
</tr>
<tr>
<td>17 Pilu et al (2007); Italy</td>
<td>30 clinically depressed women, aged 40-60 years</td>
<td>Depression: Hamilton Rating Scale</td>
<td>LTPA</td>
<td>Accompanied (with supervisor)</td>
<td>-</td>
</tr>
<tr>
<td>18 Pinchasov et al (2000); Russia</td>
<td>63 women, aged 17-51 (with winter depression, non-seasonal depression or non-depressed)</td>
<td>Depression: Hamilton Depression Rating Scale</td>
<td>LTPA</td>
<td>NA (Supervised)</td>
<td>-</td>
</tr>
</tbody>
</table>

PA, Physical activity; LTPA, Leisure-time physical activity; RCT, Randomised Controlled Trial; BDI, Beck Depression Inventory; CES-D, Centre for Epidemiologic Studies Depression Scale; GHQ, General Health Questionnaire; POMS, Profile of Mood State; RPC, Rating of Perceived Change
- = Significant inverse association between PA and depression
0 = N/S
NA = Not assessed
<table>
<thead>
<tr>
<th>Author/year</th>
<th>Sample &amp; study type</th>
<th>Depression measure</th>
<th>Sedentary behavior measure</th>
<th>Context</th>
<th>Relationship with depression</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Bessiere et al (2010); US</td>
<td>740 men &amp; women, aged 13-101 Longitudinal</td>
<td>CES-D</td>
<td>Internet: 27 item questionnaire, assessing internet use and purpose</td>
<td>Internet - Family/friend communication</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Internet - health-related research</td>
<td>+</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Internet - Meet new people</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Internet – entertainment</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Internet – shopping</td>
<td>0</td>
</tr>
<tr>
<td>2 Bessiere et al (2008); US</td>
<td>1,045 men and women, aged 13-101 Longitudinal</td>
<td>CES-D</td>
<td>Internet: 27 item questionnaire, assessing internet use and purpose</td>
<td>Internet - Family/friend communication</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Internet - health-related research</td>
<td>+</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Internet - Meet new people</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Internet – entertainment</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Internet – shopping</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Computer use: Question asking weekly time spent using the computer</td>
<td>+</td>
</tr>
<tr>
<td>Author/year</td>
<td>Sample &amp; study type</td>
<td>Depression measure</td>
<td>Sedentary behavior measure</td>
<td>Context</td>
<td>Relationship with depression</td>
</tr>
<tr>
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</tr>
<tr>
<td>4 Dittmar (1994); US</td>
<td>48 college students (men and women), aged 18-24, Cross-sectional</td>
<td>MMPI</td>
<td>TV viewing: Using a log (log how many hours/programs you watch on TV)</td>
<td>TV viewing</td>
<td>+</td>
</tr>
<tr>
<td>5 Hamer et al (2010); UK</td>
<td>3920 men and women, mean age = 51, Cross-sectional</td>
<td>GHQ-12</td>
<td>TV and screen-based entertainment: Questionnaire asking to report total time spent in TV and screen-based entertainment</td>
<td>TV/Screen-based entertainment</td>
<td>+</td>
</tr>
<tr>
<td>6 King et al (2010); US</td>
<td>5,556 adults, mean age = 48, Cross-sectional</td>
<td>One question: ‘Have you suffered depression in the past year?’ (Y/N)</td>
<td>TV viewing: One question: ‘In the past week, how many hours did you spend watching TV?’</td>
<td>TV viewing</td>
<td>+</td>
</tr>
<tr>
<td>7 Kleinke et al (1988); US</td>
<td>369 men and 389 women (college students, pain patients and Veterans), aged 17-83, Cross-sectional</td>
<td>BDI and the Depression Coping Questionnaire (Factor 10) ‘I watch TV’</td>
<td>TV viewing: Depression Coping Questionnaire</td>
<td>TV viewing</td>
<td>+</td>
</tr>
<tr>
<td>8 Morgan et al (2003); US</td>
<td>287 college ‘freshmen’ (mean age 18), Cross-sectional</td>
<td>CES-D</td>
<td>Internet usage: Divided into use for communication and non-communication. Questionnaire asked for the number of hours p/wk participants spent using e-mail, and chat rooms</td>
<td>Internet - E-mail</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Internet- Chat-room</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Internet surfing hours</td>
<td>+</td>
</tr>
<tr>
<td>Author/year</td>
<td>Sample &amp; study type</td>
<td>Depression measure</td>
<td>Sedentary behavior measure</td>
<td>Context</td>
<td>Relationship with depression</td>
</tr>
<tr>
<td>------------------------------</td>
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</tr>
<tr>
<td>9 Morrison et al (2010); UK</td>
<td>1,319 men and women, aged 16-51</td>
<td>BDI</td>
<td>Internet usage: Young’s IAT and the Internet Function Questionnaire</td>
<td>Internet – Games</td>
<td>+</td>
</tr>
<tr>
<td></td>
<td>Cross-sectional</td>
<td></td>
<td></td>
<td>Internet – Chat</td>
<td>+</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Internet – surfing</td>
<td>+</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Internet – sexually gratifying sites</td>
<td>+</td>
</tr>
<tr>
<td>10 Sanchez et al (2008); US</td>
<td>394 overweight/obese women, aged 18-55</td>
<td>CES-D</td>
<td>Sedentary time: Accelerometer</td>
<td>Sedentary time</td>
<td>+</td>
</tr>
<tr>
<td></td>
<td>Cross-sectional</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>11 Sanchez-Villegas et al (2008); Spain</td>
<td>10,381 university graduates (mean age = approx 42)</td>
<td>Question: ‘Have you ever been diagnosed of depression by a health professional?’ (Y/N)</td>
<td>TV/computer use (Sedentary Index): Question asking ‘hours per week spent watching TV/computer use?’</td>
<td>TV/computer use</td>
<td>+</td>
</tr>
<tr>
<td>12 Sidney et al (1996); US</td>
<td>4280 men and women, aged 23-35</td>
<td>CES-D</td>
<td>TV viewing (Questionnaire): ‘During LT, how many hours per day do you watch TV?’</td>
<td>TV viewing</td>
<td>+</td>
</tr>
<tr>
<td>Author/year</td>
<td>Sample &amp; study type</td>
<td>Depression measure</td>
<td>Sedentary behavior measure</td>
<td>Context</td>
<td>Relationship with depression</td>
</tr>
<tr>
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<td>-----------------------------</td>
</tr>
<tr>
<td>Thomee et al (2007); Sweden</td>
<td>1127 younger adults (men and women), aged 18-25 Longitudinal</td>
<td>The psychiatric Prime-MD screening form (2 items)</td>
<td>Computer/internet: Questionnaire asking how much time in the past 7 days have participants used computers, surfed the Internet, chatted online, e-mailed (also mobile phone use-N/A)</td>
<td>ICT (including mobile phone)</td>
<td>+</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Internet -E-mail</td>
<td>+</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Internet – Chat</td>
<td>+</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Overall computer use</td>
<td>0</td>
</tr>
</tbody>
</table>

SB, Sedentary behaviour; CESD, Centre for Epidemiologic Scale for Depression; BDI, Beck Depression Inventory; MMPI, Minnesota Multiphasic Personality Inventory; GHQ, General Health Questionnaire; CIDI, Composite International Diagnostic Interview

- = Significant inverse association between SB and depression
+ = Significant positive association between SB and depression
<table>
<thead>
<tr>
<th>Author/year</th>
<th>Sample &amp; study type</th>
<th>Depression measure</th>
<th>Sedentary behaviour measure</th>
<th>Relationship with depression</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Kraut et al (1998); US</td>
<td>256 men and women (from 93 families), aged 10+ Intervention</td>
<td>CES-D</td>
<td>Internet usage: Software recorded total hours p/week that the participant connected to internet</td>
</tr>
<tr>
<td>2</td>
<td>Kraut et al (2002); US (Study 1)</td>
<td>208 men and women, aged 10+ Intervention</td>
<td>CES-D</td>
<td>Internet usage: Software recorded total hours p/week that the participant connected to internet</td>
</tr>
<tr>
<td>3</td>
<td>Kraut et al (2002); US (Study 2)</td>
<td>406 men and women, aged 10+ RCT</td>
<td>CES-D</td>
<td>Internet/computer usage: Questionnaire asking how often participants use the internet/e-mail/computer</td>
</tr>
<tr>
<td>4</td>
<td>Shaw et al (2002) US</td>
<td>40 undergraduate students (age NA) Intervention study/Randomized Trial</td>
<td>CES-D</td>
<td>Computer/internet: 5 Internet/chat sessions were scheduled (b/w 2 participants), and face-face interviews with the experimenter were carried out</td>
</tr>
</tbody>
</table>

CESD, Centre for Epidemiologic Scale for Depression; RCT, Randomized Controlled Trial
- = Significant inverse association between SB and depression
+ = Significant positive association between SB and depression
0 = No association between SB and depression
<table>
<thead>
<tr>
<th>Author</th>
<th>Sample &amp; study type</th>
<th>Intra-personal</th>
<th>R/ship</th>
<th>Social</th>
<th>R/ship</th>
<th>Physical-environmental</th>
<th>R/ship</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Ball et al (2006); Australia</td>
<td>56 women aged 18-65 from various SEP areas. Qualitative study</td>
<td>Negative experiences with PA as children – low &amp; mid SEP groups</td>
<td>R</td>
<td>Lacking exercise companion – some women enjoy time on own for PA</td>
<td>NR</td>
<td>Local neighbourhood - poor aesthetic</td>
<td>R</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Lack of time (associated with feeling tired/lack energy) – all SEP groups</td>
<td>R</td>
<td>Safety</td>
<td>R</td>
<td>Crime</td>
<td>R</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Lack of motivation – all SEP groups</td>
<td>R</td>
<td>Lack of facilities</td>
<td>NR</td>
<td>Safety</td>
<td>R</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Too tired – due to work – particularly low &amp; mid SEP groups</td>
<td>R</td>
<td>Cost</td>
<td>NR</td>
<td>Lack of facilities</td>
<td>R</td>
</tr>
<tr>
<td></td>
<td></td>
<td>TV watching/sedentary behaviours</td>
<td>R</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2 Bove et al (2006); US</td>
<td>28 low-income rural women, aged 18+. Qualitative study</td>
<td>NA</td>
<td>NA</td>
<td></td>
<td>NA</td>
<td>Transportation problems (causing lack of access to facilities): due to;</td>
<td>R</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>- Cost (of owning a car)</td>
<td></td>
<td>- Weather barriers</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>- Lack of public transport</td>
<td></td>
<td>- Walking difficult due to muddy or snow covered roads</td>
<td>R</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Few street lights (makes difficult for walking)</td>
<td>R</td>
</tr>
<tr>
<td>Author</td>
<td>Sample &amp; study type</td>
<td>Intra-personal</td>
<td>R/ship</td>
<td>Social</td>
<td>R/ship</td>
<td>Physical-environmental</td>
<td>R/ship</td>
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<td>--------</td>
</tr>
<tr>
<td>3 Brown et al (2001);</td>
<td>543 mothers of young children from differing SEP, Mean age = 33.</td>
<td>Lack of time (due to children, then housework, shopping)</td>
<td>R</td>
<td>Lack exercise companion</td>
<td>R</td>
<td>No transport</td>
<td>R</td>
</tr>
<tr>
<td>Australia</td>
<td>Cross-sectional (with aspect of qualitative)</td>
<td>Lack of money</td>
<td>R</td>
<td>Partner gave encouragement to engage in PA</td>
<td>R</td>
<td></td>
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</tr>
<tr>
<td></td>
<td></td>
<td>Lack of energy</td>
<td>R</td>
<td>Family/friends gave encouragement to be PA</td>
<td>R</td>
<td>Low social support from partner</td>
<td>R</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Don’t feel sporty</td>
<td>R</td>
<td>Low social support from partner</td>
<td></td>
<td>R</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Don’t enjoy PA</td>
<td>R</td>
<td>Low social support from friends/family</td>
<td>R</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Poor health</td>
<td>R</td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>4 Brownson et al (2001);</td>
<td>1,819 adults (women looked at separately), of varying SEP. Cross-sectional study</td>
<td>Get exercise at job = most commonly reported barrier to PA</td>
<td>R</td>
<td>Exercising with a friend/family</td>
<td>R</td>
<td>Have access to places to exercise</td>
<td>R</td>
</tr>
<tr>
<td>US</td>
<td></td>
<td>Lack of time</td>
<td>R</td>
<td>Friends who encourage PA (enabler)</td>
<td>R</td>
<td>Low SEP women reported less access to walking trails, parks and treadmills compared to high SEP women</td>
<td>R</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Too tired/lack of energy</td>
<td>R</td>
<td>Low SEP women more likely to report heavy traffic and unattended dogs</td>
<td>R</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Low SEP women less likely to report enjoyable scenery</td>
<td>R</td>
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Table A.3.1 (Continued) Correlates of physical activity in socio-economically disadvantaged women

<table>
<thead>
<tr>
<th>Author</th>
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<th>Physical-environmental</th>
<th>R/ship</th>
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<tbody>
<tr>
<td>5</td>
<td>Chang et al (2008); US</td>
<td>80 low income mothers, aged 18-35 Qualitative</td>
<td>Children/family responsibilities</td>
<td>R</td>
<td>NA</td>
<td>NA</td>
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<tr>
<td>6</td>
<td>Clark et al (1999); US</td>
<td>628 urban, low-income patients aged 55+. Cross-sectional.</td>
<td>Past vicarious experiences</td>
<td>R</td>
<td>Family verbal persuasion</td>
<td>R</td>
<td>Poor weather (barrier)</td>
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<td></td>
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<td></td>
<td>Knowledge</td>
<td>R</td>
<td>Doctor verbal persuasion</td>
<td>R</td>
<td>Poor/no sidewalk (barrier)</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>Current exercise experience</td>
<td>R</td>
<td></td>
<td>R</td>
<td>No place to sit down (barrier)</td>
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<td></td>
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<td></td>
<td>Previous exercise experience</td>
<td>R</td>
<td></td>
<td>R</td>
<td>Crime/safety (barrier)</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>Pain with exercise (barrier)</td>
<td>R</td>
<td></td>
<td>R</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Fear of chest pain, swelling, shortness of breath</td>
<td>R</td>
<td></td>
<td>R</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>Fear of falling (barrier)</td>
<td>R</td>
<td></td>
<td>R</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Fair-poor perceived health</td>
<td>R</td>
<td></td>
<td>R</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Difficulty climbing stairs</td>
<td>R</td>
<td></td>
<td>R</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>Difficulty walking a block</td>
<td>R</td>
<td></td>
<td>R</td>
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Table A.3.1 (Continued) Correlates of physical activity in socio-economically disadvantaged women

<table>
<thead>
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<th>R/ship</th>
<th>Physical-environmental</th>
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<tbody>
<tr>
<td>7 Cleland et al (2010); Australia</td>
<td>291 women with low education attainment, mean age = 48 Cross-sectional</td>
<td>Self efficacy</td>
<td>+</td>
<td>Social support from friend/family</td>
<td>0</td>
<td>Busy roads to cross</td>
<td>0</td>
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<tr>
<td></td>
<td></td>
<td>Enjoyment of walking</td>
<td>+</td>
<td>Perceived aesthetics</td>
<td>0</td>
<td></td>
<td>0</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Intention to be active</td>
<td>+</td>
<td>Perceived safety</td>
<td>0</td>
<td></td>
<td>0</td>
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<tr>
<td></td>
<td></td>
<td>Having set PA routine</td>
<td>+</td>
<td>Local access to places to walk</td>
<td>0</td>
<td></td>
<td>0</td>
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<tr>
<td></td>
<td></td>
<td>TV viewing</td>
<td>0</td>
<td>Footpaths good condition</td>
<td>0</td>
<td></td>
<td>0</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Heavy traffic</td>
<td>0</td>
<td></td>
<td>0</td>
</tr>
<tr>
<td>8 Hoebeke et al (2008); US</td>
<td>14 low income women, aged 18+ Qualitative</td>
<td>Fatigue</td>
<td>R</td>
<td>Lack of childcare</td>
<td>R</td>
<td>Weather</td>
<td>R</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Culture</td>
<td>R</td>
<td>Cost</td>
<td>R</td>
<td></td>
<td>R</td>
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<td></td>
<td></td>
<td>Health problems</td>
<td>R</td>
<td>Lack of transport</td>
<td>R</td>
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<td>R</td>
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<tr>
<td></td>
<td></td>
<td>Motivation</td>
<td>R</td>
<td>Unsafe neighbourhood</td>
<td>R</td>
<td></td>
<td>R</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Time constraints</td>
<td>R</td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td></td>
<td></td>
<td>Physical discomfort</td>
<td>R</td>
<td></td>
<td></td>
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</tr>
<tr>
<td></td>
<td></td>
<td>Self conscious about looks</td>
<td>R</td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Lack of results</td>
<td>R</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Low self-esteem</td>
<td>R</td>
<td></td>
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<td>R/ship</td>
<td>Physical-environmental</td>
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<tr>
<td>Juarbe (1998); US</td>
<td>24 low-income, immigrant Mexican women (aged 21-40), Qualitative study</td>
<td>Lack of time (family/work)</td>
<td>R</td>
<td>Negative social support = less/no PA</td>
<td>R</td>
<td>NA</td>
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<tr>
<td></td>
<td></td>
<td>Socio-cultural constraints (barrier)</td>
<td>R</td>
<td>Positive social support (asking friends/family for information about PA)</td>
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<tr>
<td>Osuji et al (2006); US</td>
<td>2,510 rural women (various SEP), aged 18-94, Cross-sectional study</td>
<td>Too tired (barrier)</td>
<td>-</td>
<td>No one to exercise with (barrier)</td>
<td>-</td>
<td>Bad weather</td>
<td>0</td>
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<tr>
<td></td>
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<td>Lack of time</td>
<td>0</td>
<td>Others discourage me</td>
<td>0</td>
<td>Community not safe from traffic</td>
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<tr>
<td></td>
<td></td>
<td>No energy (barrier)</td>
<td>-</td>
<td>No childcare (inversely related to not meeting PA recommendations, therefore enabler)</td>
<td>-</td>
<td>Afraid of dogs</td>
<td>0</td>
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<tr>
<td></td>
<td></td>
<td>No motivation</td>
<td>0</td>
<td></td>
<td></td>
<td>Community not safe from crime</td>
<td>0</td>
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<tr>
<td></td>
<td></td>
<td>Don’t like to exercise (barrier)</td>
<td>-</td>
<td></td>
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<td>No safe place to exercise</td>
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<tr>
<td></td>
<td></td>
<td>Get enough exercise at job</td>
<td>0</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>Afraid of injury</td>
<td>-</td>
<td></td>
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<td>Self-conscious about looks</td>
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<td></td>
<td></td>
<td>Poor health</td>
<td>-</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>Adult care-giving duties</td>
<td>0</td>
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Table A.3.1 (Continued) Correlates of physical activity in socio-economically disadvantaged women

<table>
<thead>
<tr>
<th>Author</th>
<th>Sample &amp; study type</th>
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<th>R/ship</th>
<th>Physical-environmental</th>
<th>R/ship</th>
</tr>
</thead>
<tbody>
<tr>
<td>11 Treiber et al (1991); US</td>
<td>Study 2 = 238 low-middle-class adults (mean age 36) Cross-sectional</td>
<td>NA</td>
<td>Family support (LTPA)</td>
<td>+</td>
<td>NA</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>Friend support (LTPA)</td>
<td>+</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>Friend &amp; family support for total PA</td>
<td>+</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>NA</td>
<td></td>
<td></td>
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<tr>
<td>12 Wilbur et al (2002); US</td>
<td>48 low-income, urban African-American women, aged 20-50 years Qualitative study</td>
<td>Self-conscious (fear being teased) (barrier)</td>
<td>R</td>
<td>Lack of community support (barrier)</td>
<td>R</td>
<td>Lack safety in neighbourhood</td>
<td>R</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Culture/race (“exercise seen more by Caucasian women”)</td>
<td>R</td>
<td>Lack of role models (barrier)</td>
<td>R</td>
<td>Public transport (both ENABLER and BARRIER)</td>
<td>R</td>
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<tr>
<td></td>
<td></td>
<td>Occupation (barrier or enabler for work-related PA)</td>
<td>R</td>
<td>No access to places to be active</td>
<td>R</td>
<td>Cost</td>
<td>R</td>
</tr>
<tr>
<td>13 Yeager et al (1993); US</td>
<td>32,852 women of varying SEP, aged 18+ Cross-sectional</td>
<td>Race (being black associated with lower LTPA)</td>
<td>+</td>
<td>NA</td>
<td>NA</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Age</td>
<td>0</td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td>Marital status</td>
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<tr>
<td></td>
<td></td>
<td>Education</td>
<td>0</td>
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</tbody>
</table>

+ = Significant positive relationship between factor and physical activity; - = Significant negative relationship between factor and physical activity; 0 = No significant relationship between factor and physical activity; R = commonly reported influence on PA (for qualitative studies); NR = Not commonly reported; LTPA, Leisure-time physical activity; SEP, Socio-economic position.
<table>
<thead>
<tr>
<th></th>
<th>Author</th>
<th>Sample &amp; study type</th>
<th>Type of sedentary behaviour</th>
<th>Correlates</th>
<th>R/ship</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Bertrais et al (2005); France</td>
<td>1932 women (and 1902 men), aged 50-69. Cross-sectional</td>
<td>TV viewing/computer use</td>
<td>Waist circumference</td>
<td>+</td>
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<tr>
<td>2</td>
<td>Brown et al (2003); Australia</td>
<td>529 women from a preschool health project (plus 185 men and women 'workers') Cross-sectional</td>
<td>Sitting time</td>
<td>Occupational status (home duties, part time, full-time)</td>
<td>T+</td>
</tr>
<tr>
<td>3</td>
<td>Buchowski et al (1996); US</td>
<td>123 obese and non-obese men and women, mean age = 38 Cross-sectional</td>
<td>TV viewing</td>
<td>BMI</td>
<td>+</td>
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<tr>
<td>4</td>
<td>Buckworth et al (2004); US</td>
<td>493 college students, mean age = 24. Cross-sectional</td>
<td>TV viewing, Studying, Computer use</td>
<td>Physical activity</td>
<td>-</td>
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<tr>
<td>5</td>
<td>Cameron et al (2003); Australia</td>
<td>11,247 men and women, aged 25+ Cross-sectional</td>
<td>TV viewing</td>
<td>BMI, Waist circumference</td>
<td>+</td>
</tr>
<tr>
<td>6</td>
<td>Clark et al (2010); Australia</td>
<td>6,001 women (and 4950 men), aged 25-91 Cross-sectional</td>
<td>TV viewing</td>
<td>Living alone</td>
<td>0</td>
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<tr>
<td>7</td>
<td>Cleland et al (2008); Australia</td>
<td>2,410 men and women, aged 26-36. Cross-sectional</td>
<td>TV viewing</td>
<td>Obesity (waist circumference), Alcohol consumption, Soft drink consumption, Snacking</td>
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Table A.3.2 (Continued) Correlates of sedentary behaviour in women

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<tr>
<td>8</td>
<td>Crawford et al (1999); Australia</td>
<td>428 high-income women, 277 low-income women, aged 20-45</td>
<td>TV viewing</td>
<td>Income</td>
</tr>
<tr>
<td>9</td>
<td>De Cocker et al (2010); Australia</td>
<td>5,562 women, mean age = 25</td>
<td>Sitting time</td>
<td>BMI</td>
</tr>
<tr>
<td>10</td>
<td>Duvigneaud et al (2007); Belgium</td>
<td>2308 women (and 2595 men), aged 18-75</td>
<td>TV viewing</td>
<td>BMI and waist circumference</td>
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<tr>
<td>11</td>
<td>Fitzgerald et al (1997); US</td>
<td>2452 men and women, aged 21-59</td>
<td>TV viewing</td>
<td>BMI, Past year LTPA, Past year occupational PA, Past year total PA</td>
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<tr>
<td>12</td>
<td>Healy et al (2008); Australia</td>
<td>2,033 women (and 2,031 men), aged 25+</td>
<td>TV viewing</td>
<td>Waist circumference (weight), Other health-related correlates also identified eg. HDL cholesterol</td>
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<tr>
<td>13</td>
<td>Jacoby et al (2003); US</td>
<td>1,161 families (1,079 women), mean age = approx 38</td>
<td>TV viewing</td>
<td>BMI</td>
</tr>
<tr>
<td>14</td>
<td>Jakes et al (2003); UK</td>
<td>15,515 men and women, aged 45-74</td>
<td>TV viewing</td>
<td>BMI, Other health-related correlates also identified eg. cholesterol etc.</td>
</tr>
<tr>
<td>Author</td>
<td>Sample &amp; study type</td>
<td>Type of sedentary behaviour</td>
<td>Correlates</td>
<td>R/ship</td>
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</tr>
<tr>
<td>Jeffery et al (1998); US</td>
<td>1,059 men and women (529 high-income, 332 low-income), aged 20-45</td>
<td>TV viewing</td>
<td>Energy intake</td>
<td>+</td>
</tr>
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<td></td>
<td></td>
<td></td>
<td>Exercise</td>
<td>0</td>
</tr>
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<td></td>
<td></td>
<td></td>
<td>BMI</td>
<td>+</td>
</tr>
<tr>
<td>Johnson et al (2006); US</td>
<td>1,555 female veterans</td>
<td>TV viewing</td>
<td>BMI</td>
<td>+</td>
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<tr>
<td>Kronenberg et al (2000); US</td>
<td>1,778 men and women, mean age = 49 years.</td>
<td>TV viewing</td>
<td>BMI</td>
<td>+</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>Waist circumference</td>
<td>+</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>Risk of being overweight</td>
<td>+</td>
</tr>
<tr>
<td>Leite et al (2006); Italy</td>
<td>1415 individuals (705 men and 710 women), aged 40-74</td>
<td>TV viewing</td>
<td>BMI</td>
<td>+</td>
</tr>
<tr>
<td>Liebman et al (2003); US</td>
<td>889 females (and 928 males), aged 18-99 from rural communities.</td>
<td>TV viewing</td>
<td>BMI (in particular women &lt;50)</td>
<td>+</td>
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<tr>
<td>Martinez-Gonzalez et al (1999); Spain</td>
<td>15,239 men and women, aged 15+.</td>
<td>Hours spent sitting (at work, at home, in car etc.)</td>
<td>BMI</td>
<td>+</td>
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<tr>
<td>Matthews et al (2008); US</td>
<td>6,329 males and females. Aged 6+.</td>
<td>Overall sedentary behaviour (as measured by activity monitor)</td>
<td>Age</td>
<td>+</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Race</td>
<td>+</td>
</tr>
<tr>
<td>Author</td>
<td>Sample &amp; study type</td>
<td>Type of sedentary behaviour</td>
<td>Correlates</td>
<td>R/ship</td>
</tr>
<tr>
<td>------------------------</td>
<td>-------------------------------------------------------------------------------------</td>
<td>-------------------------------------------</td>
<td>----------------------------------------------------------------------------</td>
<td>--------</td>
</tr>
<tr>
<td>Pomerleau et al (1999); UK</td>
<td>291 South Asian, 303 Afro-Caribbean, and 559 European women, aged 40-69. Cross-sectional</td>
<td>TV viewing</td>
<td>BMI (European women only)</td>
<td>+</td>
</tr>
<tr>
<td>Sanchez et al (2008); US</td>
<td>394 overweight/obese women, aged 18-55. Cross-sectional</td>
<td>Sedentary behaviour (measured using accelerometer)</td>
<td>Age, Race, BMI, Employment (compared to unemployed), Number of children, Meeting PA guidelines, Poor eating habits</td>
<td>0</td>
</tr>
<tr>
<td>Sidney et al (1996); US</td>
<td>4280 men and women, aged 23-35. Cross-sectional</td>
<td>TV viewing</td>
<td>Age (in White women only), Education, Income (except White women), Employed, Physical activity level</td>
<td>-</td>
</tr>
<tr>
<td>Sugiyama et al (2007); Australia</td>
<td>2,224 men and women, aged 20-65. Cross-sectional</td>
<td>TV viewing</td>
<td>SES, Age, Education, Employment status (working?), Income level, BMI, Leisure-time PA</td>
<td>-</td>
</tr>
</tbody>
</table>
Table A.3.2 (Continued) Correlates of sedentary behaviour in women

<table>
<thead>
<tr>
<th>Author</th>
<th>Sample &amp; study type</th>
<th>Type of sedentary behaviour</th>
<th>Correlates</th>
<th>R/ship</th>
</tr>
</thead>
<tbody>
<tr>
<td>26   Sugiyama et al (2008);</td>
<td>2,046 men and women,</td>
<td>TV viewing</td>
<td>Age</td>
<td>+</td>
</tr>
<tr>
<td>Australia</td>
<td>aged 20-65, Cross-sectional</td>
<td></td>
<td>BMI</td>
<td>+</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Other sedentary time</td>
<td>+</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Computer time</td>
<td>+</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Video games time</td>
<td>+</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Reading time</td>
<td>+</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Sitting/talking time</td>
<td>+</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Car driving time</td>
<td>+</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>LTPA time</td>
<td>-</td>
</tr>
<tr>
<td>27   Sugiyama et al (2008);</td>
<td>2,210 adults, aged 20-65</td>
<td>Sedentary behaviour (includes TV viewing, computer use, sitting, reading,</td>
<td>BMI</td>
<td>+</td>
</tr>
<tr>
<td>Australia</td>
<td>Cross-sectional</td>
<td>driving)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>28   Tucker et al (1991);</td>
<td>4,771 adult females, aged</td>
<td>TV viewing</td>
<td>Age</td>
<td>T+</td>
</tr>
<tr>
<td>US</td>
<td>19+ Cross-sectional</td>
<td></td>
<td>Education</td>
<td>T-</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Smoking status</td>
<td>T+</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Weekly Exercise</td>
<td>T-</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Hours at work</td>
<td>T-</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Obesity</td>
<td>+</td>
</tr>
<tr>
<td>29   Varo et al (2003);</td>
<td>15,239 men and women,</td>
<td>Sitting time (+ no participation in activities)</td>
<td>BMI</td>
<td>+</td>
</tr>
<tr>
<td>Spain</td>
<td>aged 15+ (from the EU)</td>
<td></td>
<td>Education</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>Cross-sectional</td>
<td></td>
<td>Marital status</td>
<td>+</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Smoking status</td>
<td>+</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Weight change</td>
<td>0</td>
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</tbody>
</table>
Table A.3.2 (Continued) Correlates of sedentary behaviour in women

### Intra-personal Correlates

<table>
<thead>
<tr>
<th>Author</th>
<th>Sample &amp; study type</th>
<th>Type of sedentary behaviour</th>
<th>Correlates</th>
<th>R/ship</th>
</tr>
</thead>
<tbody>
<tr>
<td>30</td>
<td>Williams et al (1999); US</td>
<td>321 female (and 255 male) university seniors, mean age =25</td>
<td>TV viewing</td>
<td>Employment status -</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Cross-sectional</td>
<td></td>
<td>Ethnicity +</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Barriers to PA +</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>PA processes of change -</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Benefits of PA 0</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Enjoyment of PA 0</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Body dissatisfaction +</td>
</tr>
</tbody>
</table>

### Social Correlates

<table>
<thead>
<tr>
<th>Author</th>
<th>Sample &amp; study type</th>
<th>Type of sedentary behaviour</th>
<th>Correlates</th>
<th>R/ship</th>
</tr>
</thead>
<tbody>
<tr>
<td>30</td>
<td>Williams et al (1999); US</td>
<td>321 female (255 male) uni students, mean age =25</td>
<td>TV viewing</td>
<td>Social support for PA 0</td>
</tr>
</tbody>
</table>

### Environmental Correlates

<table>
<thead>
<tr>
<th>Author</th>
<th>Sample &amp; study type</th>
<th>Type of sedentary behaviour</th>
<th>Correlates</th>
<th>R/ship</th>
</tr>
</thead>
<tbody>
<tr>
<td>6</td>
<td>Clark et al (2010); Australia</td>
<td>6,001 women (and 4950 men), aged 25-91</td>
<td>TV viewing</td>
<td>Living in regional centres +</td>
</tr>
<tr>
<td>25</td>
<td>Sugiyama et al (2007); Australia</td>
<td>2,224 men and women, aged 20-65</td>
<td>TV viewing</td>
<td>Neighbourhood walk-ability -</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Cross-sectional</td>
<td></td>
<td>Neighbourhood SEP -</td>
</tr>
<tr>
<td>30</td>
<td>Williams et al (1999); US</td>
<td>321 female (and 255 male) university seniors, mean age =25</td>
<td>TV viewing</td>
<td>PA environment 0</td>
</tr>
</tbody>
</table>

TV, Television; PA, Physical Activity; + = Significant positive relationship between factor and sedentary behaviour; - = Significant inverse relationship between factor and sedentary behaviour; 0 = No significant relationship between factor and sedentary behaviour; T = trend in direction (significance not reported)
<table>
<thead>
<tr>
<th>Strategy</th>
<th>Paper (author), study</th>
<th>Sample characteristics</th>
<th>Impact on depression</th>
<th>Adherence %</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intra-personal</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cognitive Behavioural Therapy</td>
<td>Anderson (1999) RCT</td>
<td>40 obese women (aged 21-60)</td>
<td>-</td>
<td>88</td>
<td>Keeping PA record and use of accelerometers</td>
</tr>
<tr>
<td></td>
<td>Ansbury (2006) RCT</td>
<td>23 women (mean age = 56)</td>
<td>-</td>
<td>97</td>
<td>HR monitors, PA log (eg. duration/intensity)</td>
</tr>
<tr>
<td></td>
<td>Brown (2001) RCT</td>
<td>112 women with depressive symptoms (aged 40-60)</td>
<td>-</td>
<td>83</td>
<td>Monitoring HR (via pulse), PA log (adherence)</td>
</tr>
<tr>
<td></td>
<td>Craft (2007) RCT</td>
<td>32 women with depressive symptoms (aged 18-55)</td>
<td>-</td>
<td>75</td>
<td>Pedometers, exercise calendar, goal-setting information, provided with fitness assessment feedback</td>
</tr>
<tr>
<td></td>
<td>Cramer (1991) RCT</td>
<td>35 obese women (aged 25-45)</td>
<td>-</td>
<td>83</td>
<td>PA logs (record exercise type, duration, health)</td>
</tr>
<tr>
<td></td>
<td>King (1993) RCT</td>
<td>357 older adults (aged 50-65)</td>
<td>-</td>
<td>75 &amp; 53</td>
<td>PA logs</td>
</tr>
<tr>
<td></td>
<td>King (1989) RCT</td>
<td>120 adults (mean age = 49)</td>
<td>0</td>
<td>75</td>
<td>HR monitors and PA logs, and wore a microprocessor</td>
</tr>
<tr>
<td></td>
<td>Nabkasorn (2005) RCT</td>
<td>49 women with depressive symptoms (aged 18-20)</td>
<td>-</td>
<td>92</td>
<td>Daily PA logs</td>
</tr>
<tr>
<td></td>
<td>Nieman (2000) RCT</td>
<td>30 obese women (aged 25-70)</td>
<td>0</td>
<td>89</td>
<td>HR monitoring, weekly weigh-ins</td>
</tr>
<tr>
<td></td>
<td>Palmer (1995) RCT</td>
<td>27 women (aged 29-50)</td>
<td>0</td>
<td>NA</td>
<td>HR monitoring</td>
</tr>
<tr>
<td></td>
<td>Pinchasov (2000) RCT</td>
<td>63 depressed and non-depressed women (aged 17-51)</td>
<td>-</td>
<td>NA</td>
<td>HR monitoring</td>
</tr>
<tr>
<td>Additional resources</td>
<td>Anderson (1999) RCT</td>
<td>40 obese women (aged 21-60)</td>
<td>-</td>
<td>88</td>
<td>Video tape of exercise class for home use + LEARN manual</td>
</tr>
<tr>
<td></td>
<td>Brown (1995) RCT</td>
<td>135 adults (aged 40-60)</td>
<td>0</td>
<td>93</td>
<td>Portable cassette player to listen to instructions about relaxing from a quiet voice and slow tones (walking + relaxation group).</td>
</tr>
<tr>
<td>Strategy</td>
<td>Paper (author), study</td>
<td>Sample characteristics</td>
<td>Impact on depression</td>
<td>Adherence %</td>
<td>Example</td>
</tr>
<tr>
<td>--------------------------</td>
<td>-----------------------</td>
<td>------------------------------------------------------------</td>
<td>----------------------</td>
<td>-------------</td>
<td>-------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Education</td>
<td>Anderson (1999) RCT</td>
<td>40 obese women (aged 21-60)</td>
<td>-</td>
<td>89</td>
<td>Strategies for adopting/maintaining PA (overcoming barriers)</td>
</tr>
<tr>
<td></td>
<td>Ansbury (2006) RCT</td>
<td>23 women (mean age = 56)</td>
<td>-</td>
<td>97</td>
<td>Suggestions for exercise eg. join gym/exercise class,</td>
</tr>
<tr>
<td></td>
<td>Brown (2001) RCT</td>
<td>112 women with depressive symptoms (aged 40-60)</td>
<td>-</td>
<td>83</td>
<td>Educational session about mood-enhancing effects of PA, phone -</td>
</tr>
<tr>
<td></td>
<td>Craft (2007) RCT</td>
<td>32 women with depressive symptoms (aged 18-55)</td>
<td>-</td>
<td>75</td>
<td>strategies for maintaining PA (overcoming barriers)</td>
</tr>
<tr>
<td></td>
<td>Lee (2001) RCT</td>
<td>102 ethnic minority women (aged 25-55)</td>
<td>0</td>
<td>80</td>
<td>Provided with information how PA may help with depressive symptoms.</td>
</tr>
<tr>
<td></td>
<td>Palmer (1995) RCT</td>
<td>27 women (aged 29-50)</td>
<td>0</td>
<td>NA</td>
<td>Provided weekly written materials on health benefits of PA, pamphlets,</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>‘tip sheets’ for overcoming barriers</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Instructions were give RE the proper form for exercising and walking</td>
</tr>
<tr>
<td>Behavioural capability</td>
<td>Anderson (1999) RCT</td>
<td>40 obese women (aged 21-60)</td>
<td>-</td>
<td>89</td>
<td>Teaching HR monitoring and RPE</td>
</tr>
<tr>
<td></td>
<td>Ansbury (2006) RCT</td>
<td>23 women (mean age = 56)</td>
<td>-</td>
<td>97</td>
<td>Teaching HR (booklet for how to use HR monitor)</td>
</tr>
<tr>
<td></td>
<td>Brown (2001) RCT</td>
<td>112 women with depressive symptoms (aged 40-60)</td>
<td>-</td>
<td>83</td>
<td>Teaching HR monitoring</td>
</tr>
<tr>
<td></td>
<td>Craft (2007) RCT</td>
<td>32 women with depressive symptoms (aged 18-55)</td>
<td>-</td>
<td>75</td>
<td>Teaching RPE, and how to use a treadmill</td>
</tr>
<tr>
<td></td>
<td>King (1993) RCT</td>
<td>357 older adults (aged 50-65)</td>
<td>-</td>
<td>75 &amp; 53</td>
<td>Teaching HR monitoring</td>
</tr>
<tr>
<td></td>
<td>Palmer (1995) RCT</td>
<td>27 women (aged 29-50)</td>
<td>0</td>
<td>NA</td>
<td>Teaching HR monitoring</td>
</tr>
<tr>
<td>Individual tailoring</td>
<td>Anderson (1999) RCT</td>
<td>40 obese women (aged 21-60)</td>
<td>-</td>
<td>89</td>
<td>Participants were allowed to increase step height (intensity) if they</td>
</tr>
<tr>
<td></td>
<td>Craft (2007) RCT</td>
<td>32 women with depressive symptoms (aged 18-55)</td>
<td>-</td>
<td>75</td>
<td>needed a greater challenge</td>
</tr>
<tr>
<td></td>
<td>Nabkasorn (2005) RCT</td>
<td>49 women with depressive symptoms (aged 18-20)</td>
<td>-</td>
<td>92</td>
<td>Subjects given individualized walking program (based on exercise test</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>results)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Each subject jogged at their own pace</td>
</tr>
</tbody>
</table>
Table A.3.3 (Continued) Physical activity intervention strategies used in physical activity/depression interventions

<table>
<thead>
<tr>
<th>Strategy</th>
<th>Paper (author), study</th>
<th>Sample characteristics</th>
<th>Impact on depression</th>
<th>Adherence %</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>Progression</td>
<td>Brown (1995) RCT</td>
<td>135 adults (aged 40-60)</td>
<td>-</td>
<td>93</td>
<td>For walking and Tai chi groups. Distance and duration increased at certain points (weeks). Also more advanced Tai Chi was introduced as subjects improved.</td>
</tr>
<tr>
<td></td>
<td>King (1993) RCT</td>
<td>357 older adults (aged 50-65)</td>
<td>-</td>
<td>75 &amp; 53</td>
<td>Increased dose</td>
</tr>
<tr>
<td></td>
<td>Nieman (2000) RCT</td>
<td>30 obese women (aged 25-70)</td>
<td>0</td>
<td>89</td>
<td>Increased dose</td>
</tr>
<tr>
<td></td>
<td>Palmer (1995) RCT</td>
<td>27 women (aged 29-50)</td>
<td>0</td>
<td>NA</td>
<td>Increased dose</td>
</tr>
</tbody>
</table>

### Social

<table>
<thead>
<tr>
<th></th>
<th>Paper (author), study</th>
<th>Sample characteristics</th>
<th>Impact on depression</th>
<th>Adherence %</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group PA program</td>
<td>Anderson (1999) RCT</td>
<td>40 obese women (aged 21-60)</td>
<td>-</td>
<td>89</td>
<td>Group aerobics classes</td>
</tr>
<tr>
<td></td>
<td>Balkin (2007) RCT</td>
<td>110 young women (mean age = 21)</td>
<td>-</td>
<td>NA</td>
<td>Group aerobics &amp; weight lifting class</td>
</tr>
<tr>
<td></td>
<td>Berger (1992) RCT</td>
<td>87 college students (mean ages 20-28)</td>
<td>-</td>
<td>91</td>
<td>Group yoga or swimming class</td>
</tr>
<tr>
<td></td>
<td>Brown (1995) RCT</td>
<td>135 adults (aged 40-60)</td>
<td>-</td>
<td>93</td>
<td>Group Tai Chi vs walking (social context NA)</td>
</tr>
<tr>
<td></td>
<td>Craft (2007) RCT</td>
<td>32 women with depressive symptoms (aged 18-55)</td>
<td>-</td>
<td>75</td>
<td>Individual vs group PA</td>
</tr>
<tr>
<td></td>
<td>King (1993) RCT</td>
<td>357 older adults (aged 50-65)</td>
<td>-</td>
<td>75 &amp; 53</td>
<td>Individual vs group PA</td>
</tr>
<tr>
<td></td>
<td>Nabkasorn (2005) RCT</td>
<td>49 women with depressive symptoms (aged 18-20)</td>
<td>-</td>
<td>92</td>
<td>Group jogging (&amp; fitness instructors)</td>
</tr>
<tr>
<td></td>
<td>Palmer (1995) RCT</td>
<td>27 women (aged 29-50)</td>
<td>0</td>
<td>NA</td>
<td>Walking group</td>
</tr>
<tr>
<td></td>
<td>Cramer (1991) RCT</td>
<td>35 obese women (aged 25-45)</td>
<td>-</td>
<td>83</td>
<td>Walking group</td>
</tr>
<tr>
<td></td>
<td>Pilu (2007) RCT</td>
<td>30 clinically depressed women (aged 40-60)</td>
<td>-</td>
<td>NA</td>
<td>Group strength exercise classes</td>
</tr>
<tr>
<td>Strategy</td>
<td>Paper (author), study</td>
<td>Sample characteristics</td>
<td>Impact on depression</td>
<td>Adherence %</td>
<td>Example</td>
</tr>
<tr>
<td>-------------------</td>
<td>-----------------------</td>
<td>------------------------</td>
<td>----------------------</td>
<td>-------------</td>
<td>-------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Coaching/supervisor/counselling</td>
<td>Brown (2001) RCT</td>
<td>112 women with depressive symptoms (aged 40-60)</td>
<td>-</td>
<td>83</td>
<td>“Coach” assigned to each participant (teaches about HR monitoring, take pulse, assist with developing strategies to integrate PA into daily routine)</td>
</tr>
<tr>
<td></td>
<td>Craft (2007) RCT</td>
<td>32 women with depressive symptoms (aged 18-55)</td>
<td>-</td>
<td>75</td>
<td>4 x 30 mins adherence counselling sessions</td>
</tr>
<tr>
<td></td>
<td>Cramer (1991) RCT</td>
<td>35 obese women (aged 25-45)</td>
<td>-</td>
<td>83</td>
<td>Supervised sessions</td>
</tr>
<tr>
<td></td>
<td>Doyne (1987) RCT</td>
<td>40 women with depressive symptoms (aged 18-55)</td>
<td>-</td>
<td>70</td>
<td>Individual sessions supervised (monitors were rotated)</td>
</tr>
<tr>
<td></td>
<td>Nieman (2000) RCT</td>
<td>30 obese women (aged 25-70)</td>
<td>0</td>
<td>89</td>
<td>Supervised sessions</td>
</tr>
<tr>
<td></td>
<td>Norvell (1991) RCT</td>
<td>43 women (mean age = 58)</td>
<td>0</td>
<td>NA</td>
<td>Supervised sessions</td>
</tr>
<tr>
<td></td>
<td>Pinchasov (2000) RCT</td>
<td>63 depressed and non-depressed women (aged 17-51)</td>
<td>-</td>
<td>NA</td>
<td>Supervised sessions</td>
</tr>
<tr>
<td></td>
<td>Palmer (1995) RCT</td>
<td>27 women (aged 29-50)</td>
<td>0</td>
<td>NA</td>
<td>Supervised sessions</td>
</tr>
<tr>
<td></td>
<td>Pilu (2007) RCT</td>
<td>30 clinically depressed women (aged 40-60)</td>
<td>-</td>
<td>NA</td>
<td>Supervised sessions</td>
</tr>
<tr>
<td>Phone calls</td>
<td>Brown (2001) RCT</td>
<td>112 women with depressive symptoms (aged 40-60)</td>
<td>-</td>
<td>83</td>
<td>Phone calls from “coach” every 2 weeks to assist in overcoming barriers to PA adherence/counsel</td>
</tr>
<tr>
<td></td>
<td>Lee (2001) RCT</td>
<td>102 ethnic minority women (aged 25-55)</td>
<td>0</td>
<td>80</td>
<td>Weekly telephone counselling</td>
</tr>
</tbody>
</table>

RCT, Randomised Controlled Trial; NA, Not Assessed; PA, Physical Activity
- = Depressive symptoms significantly decreased with intervention; 0 = Intervention had no impact on depressive symptoms.
Appendix 3

Physical activity, sedentary behavior and depression among disadvantaged women
(Published manuscript)
Physical activity, sedentary behavior and depression among disadvantaged women

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Abstract

This study investigated associations between components of physical activity (PA; e.g. domain and social context) and sedentary behaviors (SBs) and risk of depression in women from disadvantaged neighborhoods. A total of 3645 women, aged 18–45 years, from disadvantaged neighborhoods, self-reported their PA, SB and depressive symptoms. Crude and adjusted odds ratios and 95% confidence intervals were calculated for each component of PA, SB and risk of depression using logistic regression analyses, adjusting for clustering by women’s neighborhood of residence. Being in a higher tertile of leisure-time PA and transport-related PA was associated with lower risk of depression. No associations were apparent for domestic or work-related PA. Women who undertook a small proportion of their leisure-time PA with someone were less likely to be at risk of depression than those who undertook all leisure-time PA on their own. Women reporting greater time sitting at the computer, screen time and overall sitting time had higher odds of risk of depression compared with those reporting low levels. The domain and social context of PA may be important components in reducing the risk of depression. Reducing time spent in SB may be a key strategy in the promotion of better mental health in women from disadvantaged neighborhoods.

Introduction

Participation in regular physical activity (PA) [1] as well as reducing sedentary behaviors (SBs) such as television (TV) viewing [2] has a strong cardioprotective role. However, recent research has indicated that these behaviors may also play an important role in the treatment and prevention of depression [3]. Depression is the world’s most incapacitating illness [4], with nearly 20% of women from developed countries suffering from depression within their lifetime [5]. Several population groups have been found to be at a greater risk of depression, including women [6] and adults of low socioeconomic position (SEP) [7]. These population groups are also at increased risk of physical inactivity [8, 9], highlighting the importance of research that focuses on those target groups in order to improve mental health through the promotion of healthy lifestyles (i.e. increasing PA and reducing SB).

Much research has indicated the beneficial effect of PA on the risk of depression [10]. However, little is known about the specific characteristics of PA that are most beneficial to mental health, for example the domain and social context in which PA occurs. Although various observational [11] and intervention [12] studies have found leisure-time PA to be inversely associated with depression among women, few studies have assessed the association with PA undertaken in other domains (e.g. work related, domestic and transport related). Until now, only three observational studies had
specifically compared the association between PA in various domains and risk of depression in women [11, 13, 14]. All three studies concluded that leisure-time PA was inversely associated with risk of depression. One of the three also found an association in the opposite direction between domestic (household) PA and risk of depression [13], and another demonstrated a positive association between work-related PA and risk of depression [14]. No associations were evident between transport-related PA and risk of depression in women [11]. However, that study did not distinguish between different types of transport-related PAs (e.g. walking or cycling) which may be an important factor [11].

Similarly, the association between PA undertaken in different social contexts and risk of depression has received very little research attention. Only one observational study has considered the social context of PA and its association with risk of depression in women [11]. That study found that being active with a family member was associated with lower odds of depression, compared with never being active with a family member. Conversely, two intervention studies have compared the effects of differing social contexts of PA on depressive symptoms in women [15, 16]. Both interventions compared individual (home-based) PA programs with group-based (accompanied) activity programs and found significant effects of both formats in reducing participant’s depressive symptoms, with no clear benefit of either format over the other. However, one of those studies included a small sample size as well as a short follow-up period which limited results [16].

Recently research attention has focused on the association between SB (e.g. TV viewing and computer use) and depression, but this remains poorly understood. Most observational studies have found positive associations between time spent in SB (e.g. TV and computer use) and risk of depression [3, 17–21]. In contrast, two intervention studies assessing the risk of computer or Internet use and risk of depression found inverse associations between computer use and depression [22, 23], suggesting that time spent on the computer may reduce risk of depression. Only one study has assessed whether the relationship between SB and depression may be moderated by PA [3]. That longitudinal study found lower levels of SB to be associated with reduced risk of depression when PA levels were low, yet it was not a critical aspect when PA levels were high [3].

The purpose of the current study was to examine the associations between components of PA (e.g. domains and social context) and risk of depression as well as the association between SBs (e.g. TV viewing and computer use) and risk of depression using data from a large population-based sample of women living in socioeconomically disadvantaged areas. Furthermore, the study aimed to test for the presence of an interaction between PA, SB and risk of depression. It was hypothesized that leisure-time PA would be more strongly associated than other domains of PA with lower risk of depression and that activities undertaken in a social context (i.e. PA with somebody) would be more strongly associated with lower risk of depression, compared with PAs undertaken alone. It was also hypothesized that SBs such as TV viewing and sitting at the computer would be associated with higher risk of depression. Finally, it was hypothesized that the positive association between SB and risk of depression would be stronger among women doing none/low levels of PA than those who were highly active.

Methods

Analyses were based on cross-sectional survey data collected in 2007–08 from the Resilience for Eating and Activity Despite Inequality (READI) study. Data used in the present analyses were provided by 3645 women living in socioeconomically disadvantaged areas of Victoria, Australia, aged between 18 and 45 years. Methods have been described in detail elsewhere [24] and are summarized below.

Participants

Participants were randomly recruited from 80 Victorian neighborhoods (suburbs; 40 rural and 40 urban) of low SEP, based on the Australian Bureau of Statistics Socioeconomic Index for Areas [25]. The
electoral roll was then used to randomly select approximately 150 women from each of the 80 suburbs, aged between 18 and 45 years. Surveys were sent to a sample of 11,940 women, and a total of 4,934 women returned a completed survey, representing a response rate of 45% [24]. Of the respondents, 571 women were excluded due to residing in ‘non-READI’ neighborhoods. A further nine women were excluded due to falling outside the valid age range (i.e., either younger than 18 years or older than 46 years, or had data missing on this variable). Three women were excluded as the survey was not completed by the woman it was addressed to and two women later withdrew from the study. This left a total of 4,349 women included in the overall study. Since pregnancy is likely to affect both PA levels [26, 27] and risk of depression [28], 284 women (6%) were excluded from analyses because they reported being pregnant, did not know their pregnancy status or did not complete this question. A further 420 women (10%) were excluded due to having missing data on one or more covariates. This left a total of 3,645 women (74% of the original respondents) with data for inclusion in the analyses.

**Procedures**

The study was approved by the Deakin University Human Research Ethics Committee. Women were sent a pre-survey letter in the mail, informing them that they had been selected to take part in a study on women’s health and that the survey would be sent to them shortly. Surveys were posted 1 week later. Following the Dillman protocol [29], non-respondents received a mailed reminder 2 weeks later and a second reminder with a replacement survey a further 2 weeks later. Women received small incentives (e.g., tea bags and $1 scratch lottery tickets) with their initial survey package. Written consent to participate was obtained from all respondents.

**Measures**

**Domain of PA**

Self-reported PA was measured using the long-form self-administered version of the International Physical Activity Questionnaire (IPAQ-L), a validated and reliable measure involving a 7-day recall of PA behaviors [30]. Questions included the frequency and duration of time spent undertaking various intensities (walking, moderate and vigorous) of PA in leisure time, transport-related activity, work-related activity and domestic PA. For each of these four domains, participants were required to estimate the number of days, hours and minutes they spent undertaking such activities in the past week.

The total duration of PA was calculated for each variable by multiplying the frequency of activities by the duration within each domain. Further, leisure-time and work-related PA variables were summed across intensities (walking, moderate and vigorous) and transport-related PA was summed across activities (walking and cycling) to give a total duration of PA within each domain. Total (global) weekly duration of PA across all domains was also calculated. Because of the skewed nature of the distributions and the large proportions of women reporting no PA on several variables, each continuous PA variable was transformed into a categorical variable with three levels based on the tertiles within the respective distributions.

**Social context of PA**

The social context of leisure-time PA was assessed through the following question, developed for this study: ‘Thinking about all of your walking, moderate and vigorous leisure-time PA in the last 7 days, about how much of this was done ON YOUR OWN (as opposed to with someone else like family, friend or in an exercise group or class)?’. Response categories included: all, most (about three-fourth), about half, a little (about one-fourth) and none. The reliability of this measure was tested and found to be adequate (Kappa value = 0.625) [31].

**Sedentary behavior**

Three measures of SBs were included in the survey: time spent sitting at a computer, time spent sitting watching TV and overall time spent sitting. Time spent sitting watching TV and time spent sitting...
using the computer were examined separately. Participants were asked to estimate the number of hours and minutes they spent undertaking those activities on a usual weekday, as well as a weekend day. Overall sitting in the past week was assessed using the IPAQ-L. Participants were asked to estimate the number of hours and minutes spent sitting on a usual weekday, as well as a weekend day. These measures have been found to be reliable and valid in an Australian adult population [32].

Computer time, TV viewing time and sitting time were each summed to give a total weekly duration of time spent usually undertaking each of those SBs. This was done by multiplying the duration of each SB performed on weekdays by 5 (days) then adding this to the weekend days total duration [duration multiplied by 2 (days)]. The variable ‘weekly screen time’ (TV viewing + computer use) was created by summing the weekly duration for the variables ‘TV viewing’ and ‘computer use’. Each continuous SB variable was then transformed into a categorical variable based on the tertiles of the distribution.

**Depressive symptoms**

Depressive symptoms were assessed using the 10-item version of the Centre for Epidemiologic Studies Depression Scale (CES-D), a well-validated measure of depression [33, 34] that has been used in previous studies examining the association between PA and depression [35]. It includes questions that relate to various symptoms of depression that may have been experienced in the past week, which indicate whether a woman is at risk of depression. Respondents rated themselves on a four-point severity scale. CES-D scores of 10 or greater indicated that the participant was at risk of depression [34, 36, 37].

**Covariates**

Self-reported age, body mass index (BMI; not overweight (<25), overweight (25–29.9) and obese (≥30)), marital status, education, employment status, household income, children living at home, country of birth and physical health were included in the analyses as potentially confounding factors (see Table I), as these variables were bivariately associated with the risk of depression in chi-square analyses.

**Statistical analyses**

Demographic characteristics, PA, SB and risk of depression were initially examined using descriptive univariate analyses performed using SPSS version 14.0 statistical software. Bivariate associations between domains of PA, social context of PA, SB and risk of depression were examined using chi-square analyses. Crude and adjusted (controlling for confounding factors described earlier) odds ratios (ORs) and 95% confidence intervals (CIs) were then calculated for each of the PA and SB variables and risk of depression using logistic regression analyses. Further, logistic regression analyses were used to test for an interaction between SB (i.e., weekly sitting time), PA (i.e., total weekly leisure-time PA) and risk of depression. Logistic regression analyses controlled for clustering by neighborhood of residence using STATA version 10.1 statistical software package.

**Results**

Table I presents the sociodemographic characteristics and risk of depression among participants. The mean age of participants was 35 years. Just over half of the women (53%) were classed as not overweight. The majority of participants was born in Australia (89%) and was married/de facto (66%). A total of 1874 (51%) reported their highest qualification as completing high school or an apprenticeship or certificate/diploma. Just under half reported a weekly household income of $1500 or less and the majority of women had children living at home (62%). A total of 1328 (36%) participants were classified as being at risk of depression (according to the CES-D).

Table II shows the proportion of women at risk of depression according to PA and SB variables from chi-square analyses. Leisure-time walking, moderate and vigorous PA and total leisure-time PA were
Table I. Frequencies of sociodemographic characteristics among women living in socioeconomically disadvantaged neighborhoods (n = 3645)

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>n</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Age</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Under 25 years</td>
<td>608</td>
<td>17</td>
</tr>
<tr>
<td>25–29 years</td>
<td>503</td>
<td>14</td>
</tr>
<tr>
<td>30–34 years</td>
<td>538</td>
<td>15</td>
</tr>
<tr>
<td>35–39 years</td>
<td>777</td>
<td>21</td>
</tr>
<tr>
<td>40+ years</td>
<td>1219</td>
<td>33</td>
</tr>
<tr>
<td><strong>BMI category</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Not overweight (&lt;25)</td>
<td>1943</td>
<td>53</td>
</tr>
<tr>
<td>Overweight (25–29.9)</td>
<td>919</td>
<td>25</td>
</tr>
<tr>
<td>Obese (30+)</td>
<td>783</td>
<td>22</td>
</tr>
<tr>
<td><strong>Country of birth</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Australia</td>
<td>3243</td>
<td>89</td>
</tr>
<tr>
<td>Other</td>
<td>402</td>
<td>11</td>
</tr>
<tr>
<td><strong>Marital status</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Married or de facto</td>
<td>2390</td>
<td>66</td>
</tr>
<tr>
<td>Separated widowed or divorced</td>
<td>311</td>
<td>8</td>
</tr>
<tr>
<td>Never married</td>
<td>944</td>
<td>26</td>
</tr>
<tr>
<td><strong>Highest qualification</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Did not complete high school</td>
<td>799</td>
<td>22</td>
</tr>
<tr>
<td>High school/trade apprentice/certificate diploma</td>
<td>1874</td>
<td>51</td>
</tr>
<tr>
<td>University or higher degree</td>
<td>972</td>
<td>27</td>
</tr>
<tr>
<td><strong>Household income</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No income</td>
<td>21</td>
<td>&lt;1</td>
</tr>
<tr>
<td>$1–119 per week</td>
<td>18</td>
<td>&lt;1</td>
</tr>
<tr>
<td>$120–299 per week</td>
<td>54</td>
<td>2</td>
</tr>
<tr>
<td>$300–499 per week</td>
<td>151</td>
<td>4</td>
</tr>
<tr>
<td>$500–699 per week</td>
<td>296</td>
<td>8</td>
</tr>
<tr>
<td>$700–999 per week</td>
<td>509</td>
<td>14</td>
</tr>
<tr>
<td>$1000–1499 per week</td>
<td>593</td>
<td>16</td>
</tr>
<tr>
<td>$1500 per week</td>
<td>632</td>
<td>17</td>
</tr>
<tr>
<td>Other</td>
<td>1371</td>
<td>38</td>
</tr>
<tr>
<td><strong>Employment status</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Working full-time</td>
<td>1409</td>
<td>39</td>
</tr>
<tr>
<td>Working part-time</td>
<td>1092</td>
<td>30</td>
</tr>
<tr>
<td>Unemployed/laid off</td>
<td>82</td>
<td>2</td>
</tr>
<tr>
<td>Keeping house/raise children</td>
<td>829</td>
<td>23</td>
</tr>
<tr>
<td>Studying full-time</td>
<td>224</td>
<td>6</td>
</tr>
<tr>
<td>Retired</td>
<td>9</td>
<td>&lt;1</td>
</tr>
<tr>
<td><strong>Children living at home (up to 18 years)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>2261</td>
<td>62</td>
</tr>
<tr>
<td>No</td>
<td>1384</td>
<td>38</td>
</tr>
<tr>
<td><strong>Long-term illness/injury?</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>406</td>
<td>11</td>
</tr>
<tr>
<td>No</td>
<td>3239</td>
<td>89</td>
</tr>
<tr>
<td><strong>At risk of depression</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Not at risk (&lt;10)</td>
<td>2317</td>
<td>64</td>
</tr>
<tr>
<td>At risk (≥10)</td>
<td>1328</td>
<td>36</td>
</tr>
</tbody>
</table>

Each inversely associated with risk of depression. Although women in the middle tertile of moderate work-related PA (reporting 0.1–6 hours per week) were less likely to be at risk of depression than those reporting higher or lower durations, no association was found between work-related walking, vigorous or total work-related PA and risk of depression. No other domains of PA (transport related or domestic) were related to risk of depression.

The proportion of participants at risk of depression was higher among women who reported doing all leisure-time PA on their own, when compared with those who reported doing some proportion of their leisure-time PA with someone. Of the SB variables, risk of depression was positively associated with TV viewing time, screen time and overall sitting time but not associated with time spent sitting at the computer.

Table III shows the crude and adjusted (for confounders) ORs and 95% CIs from logistic regression models predicting the odds of risk of depression according to PA and SB variables.

Physical activity

Both the unadjusted and adjusted results showed that compared with those in the lowest tertile of total leisure-time PA per week (reporting less than 40 min), those in the middle and highest tertiles (greater than 40 min) had lower odds of risk of depression. When examined according to specific intensities, both the unadjusted and adjusted results indicated that compared with those who reported no walking, those who reported some walking in leisure time had lower odds of risk of depression. Results from both unadjusted and adjusted models showed that compared with women who reported no moderate-intensity leisure-time PA, women in the middle tertile (reporting between 0.1 and 1.33 hours) of moderate-intensity leisure-time PA per week had lower odds of risk of depression. Both the unadjusted and adjusted results showed that compared with those who reported no vigorous leisure-time PA per week, those in the highest tertile (reporting greater than 1.9 hours) had lower odds of risk of depression.
Table II. Proportion of women at risk of depression according to PA domain and social context and SBs

<table>
<thead>
<tr>
<th>Variables</th>
<th>Category (per week)</th>
<th>n</th>
<th>Not at risk of depression (%)</th>
<th>At risk of depression (%)</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Leisure-time PA</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Walking</td>
<td>No LT walking</td>
<td>1376</td>
<td>58</td>
<td>42</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td></td>
<td>0.1–2 hours per week</td>
<td>1214</td>
<td>67</td>
<td>33</td>
<td></td>
</tr>
<tr>
<td></td>
<td>&gt;2 hours per week</td>
<td>1000</td>
<td>67</td>
<td>33</td>
<td></td>
</tr>
<tr>
<td>Moderate</td>
<td>No moderate LTPA</td>
<td>2621</td>
<td>62</td>
<td>38</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td></td>
<td>0.1–1.33 hours per week</td>
<td>431</td>
<td>72</td>
<td>28</td>
<td></td>
</tr>
<tr>
<td></td>
<td>&gt;1.33 hours per week</td>
<td>511</td>
<td>66</td>
<td>34</td>
<td></td>
</tr>
<tr>
<td>Vigorous</td>
<td>No vigorous LTPA</td>
<td>2392</td>
<td>61</td>
<td>39</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td></td>
<td>0.1–1.9 hours per week</td>
<td>562</td>
<td>67</td>
<td>33</td>
<td></td>
</tr>
<tr>
<td></td>
<td>&gt;1.9 hours per week</td>
<td>627</td>
<td>70</td>
<td>30</td>
<td></td>
</tr>
<tr>
<td>Total leisure-time PA</td>
<td>&lt;40 min per week</td>
<td>1153</td>
<td>56</td>
<td>44</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td></td>
<td>41 min–3.4 hours per week</td>
<td>1145</td>
<td>67</td>
<td>33</td>
<td></td>
</tr>
<tr>
<td></td>
<td>&gt;3.4 hours per week</td>
<td>1226</td>
<td>68</td>
<td>32</td>
<td></td>
</tr>
<tr>
<td>Work PA</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Walking</td>
<td>No walking at work</td>
<td>1951</td>
<td>63</td>
<td>37</td>
<td>0.129</td>
</tr>
<tr>
<td></td>
<td>0.1–8 hours per week</td>
<td>831</td>
<td>66</td>
<td>34</td>
<td></td>
</tr>
<tr>
<td></td>
<td>&gt;8 hours per week</td>
<td>774</td>
<td>62</td>
<td>38</td>
<td></td>
</tr>
<tr>
<td>Moderate</td>
<td>No moderate work PA</td>
<td>2413</td>
<td>64</td>
<td>36</td>
<td>0.015</td>
</tr>
<tr>
<td></td>
<td>0.1–6 hours per week</td>
<td>708</td>
<td>67</td>
<td>33</td>
<td></td>
</tr>
<tr>
<td></td>
<td>&gt;6 hours per week</td>
<td>694</td>
<td>60</td>
<td>40</td>
<td></td>
</tr>
<tr>
<td>Vigorous</td>
<td>No vigorous work PA</td>
<td>2569</td>
<td>64</td>
<td>36</td>
<td>0.905</td>
</tr>
<tr>
<td></td>
<td>0.1–5 hours per week</td>
<td>504</td>
<td>64</td>
<td>36</td>
<td></td>
</tr>
<tr>
<td></td>
<td>&gt;5 hours per week</td>
<td>510</td>
<td>63</td>
<td>37</td>
<td></td>
</tr>
<tr>
<td>Total work PA</td>
<td>No work PA</td>
<td>1581</td>
<td>63</td>
<td>37</td>
<td>0.230</td>
</tr>
<tr>
<td></td>
<td>0.1–1.45 hours per week</td>
<td>951</td>
<td>66</td>
<td>34</td>
<td></td>
</tr>
<tr>
<td></td>
<td>&gt;1.45 hours per week</td>
<td>943</td>
<td>63</td>
<td>37</td>
<td></td>
</tr>
<tr>
<td>Transport PA</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Walking</td>
<td>&lt;30 min per week</td>
<td>1267</td>
<td>62</td>
<td>38</td>
<td>0.161</td>
</tr>
<tr>
<td></td>
<td>31–2.5 hours per week</td>
<td>1230</td>
<td>65</td>
<td>35</td>
<td></td>
</tr>
<tr>
<td></td>
<td>&gt;2.5 hours per week</td>
<td>1068</td>
<td>65</td>
<td>35</td>
<td></td>
</tr>
<tr>
<td>Cycling</td>
<td>No cycling for transport</td>
<td>3273</td>
<td>63</td>
<td>37</td>
<td>0.066</td>
</tr>
<tr>
<td></td>
<td>0.1–1 hour per week</td>
<td>169</td>
<td>69</td>
<td>31</td>
<td></td>
</tr>
<tr>
<td></td>
<td>&gt;1 hour per week</td>
<td>115</td>
<td>71</td>
<td>29</td>
<td></td>
</tr>
<tr>
<td>Total transport PA</td>
<td>&lt;30 min per week</td>
<td>1201</td>
<td>62</td>
<td>38</td>
<td>0.102</td>
</tr>
<tr>
<td></td>
<td>30 min–2.5 hours per week</td>
<td>1201</td>
<td>65</td>
<td>35</td>
<td></td>
</tr>
<tr>
<td></td>
<td>&gt;2.5 hours per week</td>
<td>1100</td>
<td>66</td>
<td>34</td>
<td></td>
</tr>
<tr>
<td>Domestic PA total</td>
<td>&lt;3 hours per week</td>
<td>1095</td>
<td>63</td>
<td>37</td>
<td>0.506</td>
</tr>
<tr>
<td></td>
<td>3–11.7 hours per week</td>
<td>1140</td>
<td>65</td>
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<tr>
<td></td>
<td>&gt;11.7 hours per week</td>
<td>1233</td>
<td>65</td>
<td>35</td>
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</tr>
<tr>
<td>Total global PA</td>
<td>&lt;11.5 hours per week</td>
<td>1055</td>
<td>64</td>
<td>36</td>
<td>0.132</td>
</tr>
<tr>
<td></td>
<td>11.5–32.3 hours per week</td>
<td>1060</td>
<td>67</td>
<td>33</td>
<td></td>
</tr>
<tr>
<td></td>
<td>&gt;32.3 hours per week</td>
<td>1108</td>
<td>63</td>
<td>37</td>
<td></td>
</tr>
<tr>
<td>Social context of leisure-time PA</td>
<td>All LTPA was done on own</td>
<td>710</td>
<td>63</td>
<td>37</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td></td>
<td>Most three-fourth LTPA done on own</td>
<td>528</td>
<td>72</td>
<td>28</td>
<td></td>
</tr>
<tr>
<td></td>
<td>About half LTPA done on own</td>
<td>454</td>
<td>66</td>
<td>34</td>
<td></td>
</tr>
<tr>
<td></td>
<td>A little (one-fourth) done on own</td>
<td>381</td>
<td>69</td>
<td>31</td>
<td></td>
</tr>
<tr>
<td></td>
<td>All LTPA done with someone</td>
<td>470</td>
<td>68</td>
<td>32</td>
<td></td>
</tr>
</tbody>
</table>

SB
Table II. Continued

<table>
<thead>
<tr>
<th>Variables</th>
<th>Category (per week)</th>
<th>n</th>
<th>Not at risk of depression (%)</th>
<th>At risk of depression (%)</th>
<th>P</th>
</tr>
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<tbody>
<tr>
<td>Computer time</td>
<td>&lt;4.75 hours per week</td>
<td>1110</td>
<td>66</td>
<td>34</td>
<td>0.094</td>
</tr>
<tr>
<td></td>
<td>4.75-21.5 hours per week</td>
<td>1127</td>
<td>64</td>
<td>36</td>
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</tr>
<tr>
<td></td>
<td>&gt;21.5 hours per week</td>
<td>1173</td>
<td>61</td>
<td>39</td>
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</tr>
<tr>
<td>TV viewing</td>
<td>&lt;13.7 hours per week</td>
<td>1152</td>
<td>67</td>
<td>33</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td></td>
<td>13.7-22.7 hours per week</td>
<td>1196</td>
<td>65</td>
<td>35</td>
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</tr>
<tr>
<td></td>
<td>&gt;22.7 hours per week</td>
<td>1207</td>
<td>59</td>
<td>41</td>
<td></td>
</tr>
<tr>
<td>Screen time</td>
<td>&lt;23.5 hours per week</td>
<td>1125</td>
<td>68</td>
<td>32</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td></td>
<td>23.5-46.3 hours per week</td>
<td>1109</td>
<td>63</td>
<td>37</td>
<td></td>
</tr>
<tr>
<td></td>
<td>&gt;46.3 hours per week</td>
<td>1149</td>
<td>60</td>
<td>40</td>
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</tr>
<tr>
<td>Sitting time</td>
<td>&lt;30.7 hours per week</td>
<td>1162</td>
<td>67</td>
<td>33</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td></td>
<td>30.7-54.5 hours per week</td>
<td>1171</td>
<td>66</td>
<td>34</td>
<td></td>
</tr>
<tr>
<td></td>
<td>&gt;54.5 hours per week</td>
<td>1198</td>
<td>59</td>
<td>41</td>
<td></td>
</tr>
</tbody>
</table>

While moderate-intensity work-related PA was associated with risk of depression in the unadjusted model, this was no longer significant in the adjusted model. Both the unadjusted and adjusted results indicated that compared with those in the lowest tertile (reporting less than 30 min per week) of transport-related PA, those in the highest tertile (reporting greater than 2.5) had lower odds of risk of depression. When examined according to specific activities, the adjusted results show that compared with those who reported less than 30 min per week of walking for transport, those who reported greater than 2.5 hours per week had lower odds of risk of depression. No associations were evident between domestic PA and odds of risk of depression in either unadjusted or adjusted models.

Social context of PA

Before and after adjusting for covariates, results showed that compared with those women who reported doing all leisure-time PA on their own, those who reported doing about three-fourth (most) leisure-time PA alone (i.e. about a quarter with others) had lower odds of risk of depression. However, this was the only category of social context to reach statistical significance.

Sedentary behavior

Both the unadjusted and adjusted results showed that compared with women in the lowest tertile (reporting less than 4.75 hours) of computer time per week, those in the highest tertile (reporting greater than 21.5 hours) had higher odds of risk of depression. TV viewing was not significantly associated with risk of depression in the adjusted model. Associations between women in the middle tertile (23.5–46.3 hours) of total screen time and risk of depression were not significant in the adjusted model. However, both the unadjusted and adjusted results showed that compared with women who reported less than 23.5 hours of total screen time per week, those who reported more than 46.3 hours per week had higher odds of risk of depression.

Unadjusted and adjusted results indicated that compared with women in the lowest tertile (reporting less than 30.7 hours) of sitting time per week, those in the highest tertile (reporting more than 54.5 hours) had higher odds of risk of depression.

Although there were significant main effects between mid and high amounts of leisure-time PA and risk of depression, there were no interactions between leisure-time PA, SB (sitting time) and risk of depression in either the unadjusted or the adjusted models.

Discussion

The current study provides novel findings regarding the domain and social context of PA as well as
### Table III. Crude and adjusted^a^ odds of risk of depression according to PA and SB variables (hours/week)^b^

<table>
<thead>
<tr>
<th>Variables</th>
<th>Category (per week)</th>
<th>Crude OR</th>
<th>95% CI</th>
<th>P</th>
<th>Adjusted^a^ OR</th>
<th>Adjusted^a^ 95% CI</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Leisure-time PA</td>
<td>No LT walking</td>
<td>1.00</td>
<td></td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Walking</td>
<td>0.1–2 hours per week</td>
<td>0.67</td>
<td>0.58–0.78</td>
<td>&lt;0.001</td>
<td>0.72</td>
<td>0.62–0.84</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td></td>
<td>&gt;2 hours per week</td>
<td>0.69</td>
<td>0.59–0.81</td>
<td>&lt;0.001</td>
<td>0.72</td>
<td>0.61–0.84</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Moderate</td>
<td>No moderate LTPA</td>
<td>1.00</td>
<td></td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>0.1–1.3 hours per week</td>
<td>0.63</td>
<td>0.51–0.77</td>
<td>&lt;0.001</td>
<td>0.67</td>
<td>0.54–0.84</td>
<td>0.001</td>
</tr>
<tr>
<td></td>
<td>&gt;1.3 hours per week</td>
<td>0.83</td>
<td>0.68–1.02</td>
<td>0.076</td>
<td>0.89</td>
<td>0.72–1.11</td>
<td>0.318</td>
</tr>
<tr>
<td>Vigorous</td>
<td>No vigorous LTPA</td>
<td>1.00</td>
<td></td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>0.1–1.9 hours per week</td>
<td>0.76</td>
<td>0.63–0.92</td>
<td>0.005</td>
<td>0.85</td>
<td>0.70–1.04</td>
<td>0.118</td>
</tr>
<tr>
<td></td>
<td>&gt;1.9 hours per week</td>
<td>0.65</td>
<td>0.54–0.79</td>
<td>&lt;0.001</td>
<td>0.69</td>
<td>0.56–0.85</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Total leisure-time PA</td>
<td>&lt;40 min per week</td>
<td>1.00</td>
<td></td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>41 min–3.4 hours per week</td>
<td>0.63</td>
<td>0.54–0.75</td>
<td>&lt;0.001</td>
<td>0.67</td>
<td>0.57–0.80</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Work PA</td>
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<td>1.00</td>
<td></td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Walking</td>
<td>0.1–8 hours per week</td>
<td>0.87</td>
<td>0.74–1.03</td>
<td>0.104</td>
<td>0.92</td>
<td>0.77–1.10</td>
<td>0.373</td>
</tr>
<tr>
<td></td>
<td>&gt;8 hours per week</td>
<td>1.06</td>
<td>0.91–1.24</td>
<td>0.419</td>
<td>1.05</td>
<td>0.88–1.25</td>
<td>0.596</td>
</tr>
<tr>
<td>Moderate</td>
<td>No moderate work PA</td>
<td>1.00</td>
<td></td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>0.1–6 hours per week</td>
<td>0.85</td>
<td>0.72–1.00</td>
<td>0.055</td>
<td>0.86</td>
<td>0.72–1.03</td>
<td>0.098</td>
</tr>
<tr>
<td></td>
<td>&gt;6 hours per week</td>
<td>1.17</td>
<td>1.01–1.36</td>
<td>0.039</td>
<td>1.10</td>
<td>0.93–1.30</td>
<td>0.281</td>
</tr>
<tr>
<td>Vigorous</td>
<td>No vigorous work PA</td>
<td>1.00</td>
<td></td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>0.1–5 hours per week</td>
<td>0.97</td>
<td>0.83–1.15</td>
<td>0.756</td>
<td>0.99</td>
<td>0.83–1.18</td>
<td>0.916</td>
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<tr>
<td></td>
<td>&gt;5 hours per week</td>
<td>1.03</td>
<td>0.86–1.23</td>
<td>0.724</td>
<td>0.94</td>
<td>0.77–1.15</td>
<td>0.535</td>
</tr>
<tr>
<td>Total work PA</td>
<td>No work PA</td>
<td>1.00</td>
<td></td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>0.1–14.5 hours per week</td>
<td>0.87</td>
<td>0.73–1.03</td>
<td>0.109</td>
<td>0.94</td>
<td>0.78–1.13</td>
<td>0.493</td>
</tr>
<tr>
<td>Transport PA</td>
<td>&lt;30 min per week</td>
<td>1.00</td>
<td></td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Walking</td>
<td>31–150 min per week</td>
<td>0.88</td>
<td>0.76–1.03</td>
<td>0.108</td>
<td>0.88</td>
<td>0.75–1.03</td>
<td>0.106</td>
</tr>
<tr>
<td></td>
<td>&gt;150 min (2.5 hours) per week</td>
<td>0.86</td>
<td>0.73–1.02</td>
<td>0.077</td>
<td>0.82</td>
<td>0.69–0.98</td>
<td>0.027</td>
</tr>
<tr>
<td>Cycling</td>
<td>No cycling for transport</td>
<td>1.00</td>
<td></td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>0.1–1 hour per week</td>
<td>0.76</td>
<td>0.54–1.08</td>
<td>0.125</td>
<td>0.87</td>
<td>0.61–1.26</td>
<td>0.467</td>
</tr>
<tr>
<td></td>
<td>&gt;1 hour per week</td>
<td>0.69</td>
<td>0.46–1.04</td>
<td>0.076</td>
<td>0.76</td>
<td>0.51–1.13</td>
<td>0.169</td>
</tr>
<tr>
<td>Total transport PA</td>
<td>&lt;30 min per week</td>
<td>1.00</td>
<td></td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>30 min–2.5 hours per week</td>
<td>0.87</td>
<td>0.74–1.02</td>
<td>0.094</td>
<td>0.87</td>
<td>0.74–1.03</td>
<td>0.108</td>
</tr>
<tr>
<td>Domestic PA total</td>
<td>&gt;2.5 hours per week</td>
<td>0.84</td>
<td>0.71–1.00</td>
<td>0.044</td>
<td>0.82</td>
<td>0.69–0.98</td>
<td>0.026</td>
</tr>
<tr>
<td></td>
<td>&lt;3 hours per week</td>
<td>1.00</td>
<td></td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>3–11.7 hours per week</td>
<td>0.91</td>
<td>0.76–1.09</td>
<td>0.323</td>
<td>0.96</td>
<td>0.80–1.15</td>
<td>0.675</td>
</tr>
<tr>
<td></td>
<td>&gt;11.7 hours per week</td>
<td>0.92</td>
<td>0.77–1.09</td>
<td>0.336</td>
<td>0.96</td>
<td>0.79–1.17</td>
<td>0.716</td>
</tr>
<tr>
<td>Total global PA</td>
<td>&lt;11.5 hours per week</td>
<td>1.00</td>
<td></td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>11.5–32.3 hours per week</td>
<td>0.88</td>
<td>0.75–1.04</td>
<td>0.143</td>
<td>0.88</td>
<td>0.75–1.04</td>
<td>0.148</td>
</tr>
<tr>
<td></td>
<td>&gt;32.3 hours per week</td>
<td>1.05</td>
<td>0.89–1.26</td>
<td>0.548</td>
<td>0.99</td>
<td>0.83–1.19</td>
<td>0.944</td>
</tr>
</tbody>
</table>
the SBs associated with risk of depression in women from socioeconomically disadvantaged neighborhoods.

Results showed that women who reported participating in greater amounts of leisure-time PA (greater than 40 min per week) were less likely to be at risk of depression than those who reported undertaking less than this. Further, results indicated an inverse relationship with risk of depression when examining the duration of leisure-time PA undertaken in each intensity (i.e. walking, moderate and vigorous). These findings suggest that greater doses of leisure-time PA may reduce the risk of depression, or alternatively people experiencing depressive symptoms spend less time in leisure-time PA, consistent with findings from previous studies [11].

The present study also found that undertaking a high dose of transport-related PA (e.g. greater than 2.5 hours) was associated with lower risk of depressive symptoms compared with those who reported lower doses. However, when examined according to each transport-related activity separately (cycling and walking), only high doses of transport-related walking was associated with a reduced likelihood of depression, suggesting that it may be the type of PA used for transport that is important. This finding is in contrast to previous studies that specifically examined and found no association between transport-related PA and risk of depression [11, 14]. However, the sample sizes of both previous studies were much smaller than that of the current study, perhaps reducing the power to detect smaller associations.

Consistent with previous studies [11], no association was found between any intensity of work-related or domestic PA and risk of depression in this study. This finding suggests that it may be the type/mode of PA, rather than the dose (i.e. intensity and duration) that is most important in determining

<table>
<thead>
<tr>
<th>Variables</th>
<th>Category (per week)</th>
<th>Crude OR</th>
<th>95% CI</th>
<th>P</th>
<th>Adjusted OR</th>
<th>Adjusted 95% CI</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Social context of leisure-time PA</td>
<td>All LTPA done on own</td>
<td>1.00</td>
<td></td>
<td></td>
<td>1.00</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Most (three-fourth) done on own</td>
<td>0.67</td>
<td>0.53-0.86</td>
<td>0.001</td>
<td>0.69</td>
<td>0.53-0.89</td>
<td>0.004</td>
</tr>
<tr>
<td></td>
<td>Half done on own</td>
<td>0.86</td>
<td>0.65-1.14</td>
<td>0.288</td>
<td>0.87</td>
<td>0.66-1.15</td>
<td>0.330</td>
</tr>
<tr>
<td></td>
<td>A little (one-fourth) done on own</td>
<td>0.75</td>
<td>0.56-1.00</td>
<td>0.050</td>
<td>0.75</td>
<td>0.56-1.01</td>
<td>0.062</td>
</tr>
<tr>
<td></td>
<td>All LTPA with someone</td>
<td>0.81</td>
<td>0.64-1.03</td>
<td>0.082</td>
<td>0.86</td>
<td>0.67-1.11</td>
<td>0.253</td>
</tr>
<tr>
<td>SB</td>
<td>Computer time</td>
<td>&lt;4.75 hours per week</td>
<td>1.00</td>
<td></td>
<td></td>
<td>1.00</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>4.75–21.5 hours per week</td>
<td>1.06</td>
<td>0.89-1.27</td>
<td>0.484</td>
<td>1.12</td>
<td>0.93-1.36</td>
</tr>
<tr>
<td></td>
<td></td>
<td>&gt;21.5 hours per week</td>
<td>1.20</td>
<td>1.02-1.41</td>
<td>0.025</td>
<td>1.35</td>
<td>1.14-1.60</td>
</tr>
<tr>
<td></td>
<td>TV viewing</td>
<td>&lt;13.7 hours per week</td>
<td>1.00</td>
<td></td>
<td></td>
<td>1.00</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>13.7–22.7 hours per week</td>
<td>1.09</td>
<td>0.91-1.29</td>
<td>0.342</td>
<td>1.05</td>
<td>0.87-1.26</td>
</tr>
<tr>
<td></td>
<td></td>
<td>&gt;22.7 hours per week</td>
<td>1.40</td>
<td>1.18-1.67</td>
<td>&lt;0.001</td>
<td>1.19</td>
<td>0.99-1.43</td>
</tr>
<tr>
<td></td>
<td>Screen time</td>
<td>&lt;23.5 hours per week</td>
<td>1.00</td>
<td></td>
<td></td>
<td>1.00</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>23.5–46.3 hours per week</td>
<td>1.21</td>
<td>1.02-1.44</td>
<td>0.030</td>
<td>1.13</td>
<td>0.93-1.37</td>
</tr>
<tr>
<td></td>
<td></td>
<td>&gt;46.3 hours per week</td>
<td>1.41</td>
<td>1.20-1.66</td>
<td>&lt;0.001</td>
<td>1.31</td>
<td>1.09-1.58</td>
</tr>
<tr>
<td></td>
<td>Sitting time</td>
<td>&lt;30.7 hours per week</td>
<td>1.00</td>
<td></td>
<td></td>
<td>1.00</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>30.7–54.5 hours per week</td>
<td>1.04</td>
<td>0.87-1.26</td>
<td>0.657</td>
<td>0.95</td>
<td>0.78-1.14</td>
</tr>
<tr>
<td></td>
<td></td>
<td>&gt;54.5 hours per week</td>
<td>1.40</td>
<td>1.19-1.65</td>
<td>&lt;0.001</td>
<td>1.28</td>
<td>1.06-1.53</td>
</tr>
</tbody>
</table>

*Adjusted for age, BMI, marital status, physical health/injury, income, education, employment status, children living at home and country of birth.

<table>
<thead>
<tr>
<th>Adjusted*</th>
<th>Adjusted 95% CI</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.53-0.89</td>
<td>0.004</td>
<td></td>
</tr>
<tr>
<td>0.66-1.15</td>
<td>0.330</td>
<td></td>
</tr>
<tr>
<td>0.56-1.01</td>
<td>0.062</td>
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<tr>
<td>0.67-1.11</td>
<td>0.253</td>
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</tr>
<tr>
<td>0.93-1.36</td>
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<tr>
<td>1.14-1.60</td>
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<tr>
<td>0.99-1.43</td>
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<td>0.93-1.37</td>
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<td>0.009</td>
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</tr>
</tbody>
</table>
the relationship with risk of depressive symptoms. These findings may be due to women’s lack of enjoyment or control when participating in work-related and domestic PA.

A number of physiological hypotheses have been suggested to explain the inverse association between PA and depression including the ‘endorphin hypothesis’, which suggests that PA produces endorphin secretion, which in turn reduces pain and produces feelings of euphoria [38]. However, the production of endorphins requires a high exercise intensity [39]. Since walking for leisure was inversely associated with risk of depression in the current study, other hypotheses such as the serotonin hypothesis [40] may be more applicable. The serotonin hypothesis suggests that exercise may reduce depression by increasing the synthesis of serotonin [41, 42], a neurotransmitter found in the brain that regulates mood and stress [43]. Furthermore, spending time outdoors (in natural light) may provide additional mental health benefits when undertaking PA as exposure to light has been found to increase serotonin synthesis [44]. Non-physiological hypotheses may also play a role in explaining the inverse association between PA and depression. These relate to distraction effects by which improvements in mental well-being following exercise may be due to the diversion of negative thoughts during the activity [45]. Alternatively, improvements following PA may be the sense of mastery and success derived from achieving goals [45].

The social context of PA was found to be associated with risk of depression in the current study, although the association was not linear and only held for those women reporting undertaking one-quarter of their leisure-time PA with someone else. The finding that reduced risk of depression was associated with doing about one-quarter of PA with someone else, but not 50% or more, is not easily explained. This may have been related to the particular categories of PA analyzed. However, in further investigation of this association, we re-categorized social context as: all leisure-time PA done on own (reference category), more than half (but not all) leisure-time PA done on own and less than half leisure-time PA done on own. Yet, results showed no significant associations between either one of those categories and risk of depression (data not shown). Further investigation of this non-linear association is required.

The current study suggested that additional mental health benefits may come from undertaking some leisure-time PA with someone else, yet not all PA with others may be associated with a lower risk of depression. This is consistent with findings from the only other cross-sectional study that has examined the association between the social context of PA and risk of depression [11]. That study found that being active with a family member was associated with a lower risk of depression, yet being active with a friend was not. Conversely, our findings may also suggest that perhaps women at risk of depression prefer to participate in PA by themselves as social withdrawal is a symptom of minor depression [46]. Since social support is widely known to be linked to lower levels of depression [47], the social context of PA may be an important component in the relationship between PA and depression.

The current study found that undertaking greater doses of computer use, screen and overall sitting time were associated with an increased risk of depressive symptoms. This is consistent with several studies that assessed SB in terms of computer/Internet use [48] and overall sitting time [21], suggesting that greater doses of SB increase the risk of depression or alternatively people experiencing depressive symptoms spend greater amounts of time in SBs.

The findings of this study indicated no interaction between SB, PA and risk of depression. In other words, contrary to expectancies, and to the findings of one existing study [3], positive associations between SB and risk of depression were not altered by participants’ leisure-time PA levels. In the previous study [3], depression was not reported exclusively as the outcome measure [e.g. the outcome measure (mental disorder) also included stress and anxiety] and a longitudinal design was used, which may account for the differences in results. However, similar to our findings, studies investigating physical health and disease
parameters have found the relationship between SB and physical health conditions such as obesity, metabolic syndrome and type 2 diabetes to be independent of PA [49–51]. Therefore, assessing the joint SB–PA–depression relationship may be an important point of consideration and area for further research.

One major limitation of the current study is its cross-sectional design, which does not allow for causality or the direction of relationships to be determined. A second limitation is that self-report measures were used to assess PA, SB and risk of depression; however, all measures were well-validated [30, 33]. Future studies could utilize objective measures such as accelerometers for assessing PA and SB. Finally, women with missing data on any covariates (e.g., education, income and BMI) were excluded from regression analyses in the present study. Chi-square analyses showed that a significantly greater proportion of women excluded for this reason were at risk of depression when compared with those who were included. Therefore, a disproportionately higher number of women at risk of depression may have been missed in analyses.

A major strength of this study is the large, population-based sample of women living in socioeconomically disadvantaged neighborhoods, which provided good power to detect associations, even after controlling for a range of important covariates. Few studies have examined the association between domain and social context of PA and risk of depression or between SB and risk of depression, particularly in women [10]. Furthermore, only one previous study has assessed the interaction between SB, PA and risk of depression [3]. This study extends this evidence to socioeconomically disadvantaged women who are a population group at a great risk of physical inactivity [8, 9] and depression [7].

Recognizing the cross-sectional nature of the current study, these findings suggest that promoting PA, particularly for leisure and transport, could be an important aspect in preventing depression. Furthermore, mental health guidelines may be developed to include some aspect of social/accompanied leisure-time PA for additional mental health benefits. Guidelines should also recommend reducing time spent in SBs (e.g., sitting time and computer use) in order to further reduce risk of depression. However, confirmation of these findings using prospective and intervention study designs is required.

Funding

Australian National Health and Medical Research Council Strategic Award (374241), National Heart Foundation of Australia Postgraduate Scholarship (Public Health) (PP 07M 3388) to M.T.; National Health and Medical Research Council Senior Research Fellowship (ID 479513) to K.B. and National Heart Foundation of Australia Career Development Award and sanofi-aventis (CR 06M 2748) to J.S.

Conflict of interest statement

None declared.

References

Appendix 4

Associations between physical activity, sedentary behaviour and risk of depression in socio-economically disadvantaged women

(Published abstract)
Method: A total of twelve elite-level swim coaches from the United States (N = 8) and Australia (N = 4) were interviewed regarding their injury management practices and perceptions on how injuries should be prevented and managed in swimming. In addition to these coaches, five injured or previously injured swimmers from various training squads were interviewed to determine their view of coach-implemented injury management programs. As a final triangulating data source, six sports medicine professionals who commonly treat swimmers (four sports physiotherapists, a sport psychologist, and a sports physician) were interviewed regarding their impressions of coach-implemented injury management programs, as well as the steps they felt should be followed to manage injury. Data were analysed following a grounded theory process of inductive analysis, where key quotes were grouped into a hierarchy of categories.

Results/Discussion: A four phase model of injury management emerged from the data. These phases were injury prevention, injury action (immediate), injury action (chronic), and return to full training, which cycles back to injury prevention. Within each of these phases, coach responsibilities for injury management included looking after the physical needs of the injured athlete as well as looking after the mental/academic needs of the athlete. For example, during the chronic injury action phase, coaches should be adjusting a swimmer's training based on the injury (physical need), and they should also be keeping the injured swimmer in as much contact with teammates as possible to avoid isolation (emotional need). In addition to coach responsibilities, a number of key swimmer behaviours associated with effective injury management emerged from the data, including training with a positive attitude, adhering to rehabilitation programs, and maintaining a willingness to work hard at training. An outline of two subsequent studies will be presented based on these preliminary findings.

Perceptions of physical activity influences among young women with and without depressive symptoms

D. Azar* • K. Ball* • J. Salmon* • V. Cleland† • Centre for Physical Activity and Nutrition Research, School of Exercise and Nutrition Sciences, Deakin University

Introduction: Young women are at high risk for developing depression, and for declining physical activity levels. Participation in physical activity may help prevent or manage depression. To encourage young women at risk of depression to be physically active, it is necessary to understand how the influences on physical activity might differ between young women with and without depressive symptoms.

Methodology: A sample of 20 women with depressive symptoms and 20 women without depressive symptoms aged 18 to 30 years participated in one-on-one semi-structured interviews. A social-ecological framework was used, focusing on the individual, social, and physical environmental influences on physical activity. Depressive symptoms were assessed by the Center for Epidemiological Studies Depression Scale (CES-D 10).

Thematic data analyses were performed.

Results: A number of key influences on physical activity that emerged from the data differed between women with and without depressive symptoms. Compared to those without symptoms, women with depressive symptoms more often described the following themes: negative early life experiences with physical activity; the impact of their mood on their physical activity (as opposed to the reverse) participation in unplanned physical activity and not using physical activity as a stress-relief strategy. Lack of time, low priority for physical activity, making excuses/procrastination and low self-efficacy for physical activity were commonly reported barriers amongst women with depressive symptoms, while lack of time, lack of motivation and lack of energy were commonly reported by women without depressive symptoms. Social influences for women with depressive symptoms included being both positively and negatively influenced by their 'family and friends' physical activity behaviour. Women with depressive symptoms also mentioned that the physical environment was less important for them in terms of being active compared to women without symptoms.

Conclusions: These findings highlight possible explanations for young women with depressive symptoms' lower physical activity participation and suggest specific potential intervention targets. Public health strategies aimed at increasing physical activity participation among young women with depressive symptoms might focus on: reducing/overcoming early life negative experiences and attitudes to physical activity, engaging more positive support from friends and family, providing awareness of the benefits of physical activity on mood, reducing barriers (e.g. providing more flexible/time-friendly strategies) and helping them feel more confident in their ability to engage in physical activity. Further quantitative research is necessary to explore the feasibility of these particular physical activity intervention strategies among young women with depressive symptoms.

Associations between physical activity, sedentary behaviour and risk of depression in socio-economically disadvantaged women

M. Toycheva** • K. Ball* • J. Salmon* • Centre for Physical Activity and Nutrition Research, School of Exercise and Nutrition Sciences, Deakin University

Introduction: Socio-economically disadvantaged women are at a high risk of being physically inactive as well as experiencing depressive symptoms. Although studies have found associations between physical activity (PA) and depression, little is known about the optimal domain and social context of PA for reducing the risk of depression. Further, few studies have assessed the relationship between sedentary behaviour (SB; e.g. TV viewing) and risk of depression. This study aimed to investigate associations between these specific components of PA and SB and risk of depression in socio-economically disadvantaged women.

Methodology: 4,062 women, aged 18–45, provided self-report validated measures of PA and SB behaviours as well as depressive symptoms. Crude and adjusted odds ratios (OR) and 95% confidence intervals (CI) were calculated for each component of PA, SB and risk of depression using logistic regression analyses, adjusting for clustering by women's suburb of residence.

Results: Being in a higher tertile of LTPA and transport-related PA was associated with a reduced risk of depression. For example, compared to those who reported less than 40 minutes leisure-time physical activity (LTPA) per week, those who reported between 41 minutes and 3.4 hours per week were 32% less likely to be at risk of depression (OR = 0.62), while those who reported more than 3.4 hours were 33% less likely to be at risk of depression (OR = 0.68). Compared to those who reported no transport-related PA per week, those who reported greater than 2.5 hours per week were less likely to be at risk of depression (OR = 0.82). No associations were apparent for domestic or work-related PA. Compared to women who undertook all LTPA on their own, those who undertook ¾ of their LTPA with someone were less likely to be at risk of depression (OR = 0.74). Women reporting greater levels of time spent watching TV, sitting at the computer and overall sitting were at a greater risk of depression compared to those reporting low levels (OR: 1.22, 1.32, 1.23 respectively).
Conclusion: Acknowledging the cross-sectional nature of this study, these findings suggest that the domain and social context of PA may be important components in reducing the risk of depression. Further, reducing time spent in SB (eg, TV viewing, computer use) may be a key strategy in the promotion of better mental health in socio-economically disadvantaged women. Confirmation of these findings using prospective and intervention study designs is required.

68 Physical activity and depression in cardiac patients following a 12-week physical activity adherence intervention

M. Regan*1,2, T. Morin1,2, B. Murphy1,2 *Heart Research Centre, 1School of Sport and Exercise Sciences, Faculty of Arts, Education and Human Development, Victoria University

Introduction: Many people experience depressive symptoms following a cardiac event. Physical activity (PA) can assist in reducing depression. However, adherence to PA can be difficult for people with depression. Very few PA adherence interventions have been designed specifically for cardiac patients with depression. The purpose of the current research was to explore the relationship between, and changes in, PA and depression, following a 12-week PA adherence intervention.

Methodology: Twenty cardiac patients, with a mean age of 51.4 (range 2 – 76 years), participated in the PA adherence intervention. The 12-week intervention was designed specifically for people with depression and cardiac disease to increase adherence to PA. The initial face-to-face consultation at baseline, and six follow-up fortnightly phone calls, utilised various psychological strategies to assist participants with PA adherence. At baseline, Week 10, and Week 24, the Cardiac Depression Scale (CDS), and CHAMPS physical activity questionnaire were used to determine depression levels, and overall and moderate intensity PA expenditure, expressed in kcal/week, respectively. As determined by the CDS, nine participants were considered at least mildly depressed at baseline, and 11 participants were not depressed.

Results: Participants who were depressed at baseline had lower levels of both moderate intensity and overall intensity PA at baseline, Week 10, and Week 24. A significant difference in moderate intensity PA was found at baseline, (t(18)=2.76, p<0.01), with depressed participants engaging in significantly lower levels of moderate PA (M=1516), than non-depressed participants (M=2286). For the depressed participants, depression scores decreased from baseline (M=102.1), to Week 10 (M=96.2), and to Week 24 (M=93.7), and moderate intensity PA increased from baseline (M=1516), to Week 10 (M=2068), but then decreased to Week 24 (M=1921). However, these differences did not reach statistical significance.

Conclusion: The current study highlights the problems associated with adherence to PA for cardiac patients with depression. Those with higher depression levels engaged in less PA at each of the three time points over the 6-month study. The PA adherence intervention appears to have been somewhat successful in reducing depression levels and increasing PA, particularly over the active intervention phase. It is important for researchers and health professionals to consider how to best encourage cardiac patients with depression to maintain PA over the long-term.

69 The effects of resistance training on depression score of individuals with multiple numbers of metabolic risk factors

I. Leoniv*1,2, D. Hare1, G. Goodman1, G. Jerusalem1, D. Dunstan1, S. Selig1 *Centre for Aging, Rehabilitation, Exercise and Sport, Victoria University, 1Department of Cardiology, Austin Health, 2Endocrine Centre of Excellence, Austin Health, 1Blair D Heart and Diabetes Institute

Introduction: Depression is more prevalent in obese individuals and those with diabetes, compared to the general population. Depression may also be a major risk factor for obesity and its related complications (such as type 2 diabetes (T2DM)) as it may lead to behavioural changes (e.g., reduced physical activity and increased energy intake). This randomised study examined the effect of resistance training (RT) on depressed mood of individuals with high BMI (n=22) and low LMIF (n=1) numbers of metabolic risk factors for T2DM as well as the validity and reliability of the cardiac depression scale (CDS) for these populations. Methods: Fifty-five participants (50.8±0.9 yr; mean±SEM) completed the SF-36 and the CDS questionnaire before and after 10 weeks of RT, as well as assessment of muscle strength (1RM). After initial allocation to HMIF or LMIF, participants were randomised to four groups, HMIF training (HMIF), HMIF control (HMIFC), LMIF training (LMIF) and LMIF control (LMIFC). One-way analysis of covariance (ANCOVA) was used to examine the effect of training on CDS score as the HMIF group had a significantly higher CDS score at baseline. Results: The HMIF group had higher depression scores at baseline, compared to the HMIFC (p<0.01). Following RT, the CDS score of the HMIF group was reduced by -14.8±4.9 points on the CDS score, a significant improvement in comparison to both baseline (p<0.01) and HMIFC (p=0.049). For HMIF, % change in muscle strength was correlated with the % change in CDS score (r=-0.42, p=0.01). The internal reliability of the CDS score was high, with Cronbach's α = 0.84. The test-retest reliability was satisfactory with a Spearman correlation = 0.77 (p<0.01).

The distribution of scores in the CDS demonstrated greater normality compared to the physical and mental health dimensions of the SF-36. Conclusions: RT alleviates depression scores in individuals with multiple numbers of metabolic risk factors for T2DM. The CDS, as a measure of depressed mood, is a responsive tool for assessing lifestyle interventions such as exercise in these individuals.

70 Effects of exercise program on depression in community-dwelling elderly

Y. Kitabatake*1,2, T. Ishiguro1, T. Nagamatsu1,2 *Physical Fitness Research Institute, 1Hiyoshi Life Foundation of Health And Welfare, 2Health Science University, Japan

Purpose: We developed a program to prevent depression involving physical exercise for persons with a tendency toward minor depressive symptoms, for use among community-dwelling elderly. This study examined the effect of this program on depression symptoms.

Methods: One thousand five hundred and thirty-four people that underwent a medical checkup responded to a questionnaire regarding basic life functions. Sixty-four subjects met the inclusion criteria for this study. We recommended that these subjects participate in a mental health seminar. Finally, 30 people who participated in the seminar became the baseline subjects. These subjects were assigned to intervention (physical exercise, n=14) or control (n=16) groups (allocation based on region non-randomized controlled trial). According to the temperature-raising hypotheses and characteristics of the subjects (elderly, safe exercise, burden of performing physical exercises), the exercise program consisted of a low-intensity and high-frequency regimen. The intervention period was 3 months. The health promotion seminar was held every two weeks (100 minutes per session). The subjects were encouraged to perform physical exercise at home everyday. The control group was instructed to continue
Appendix 5

The Resilience for Eating and Activity Despite Inequality (READI) Study 2007/2008

(Sections used in analyses)
### Section A: General Health

**A1**  Would you say your health is: (Please circle one response only)

<table>
<thead>
<tr>
<th>Excellent</th>
<th>Very good</th>
<th>Good</th>
<th>Fair</th>
<th>Poor</th>
</tr>
</thead>
</table>

**A2**  How much attention do you usually pay to: (Please circle one response on each line)

<table>
<thead>
<tr>
<th>Your personal health habits?</th>
</tr>
</thead>
<tbody>
<tr>
<td>None</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Getting enough physical activity?</th>
</tr>
</thead>
<tbody>
<tr>
<td>None</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Eating a healthy low-fat diet?</th>
</tr>
</thead>
<tbody>
<tr>
<td>None</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Controlling your weight?</th>
</tr>
</thead>
<tbody>
<tr>
<td>None</td>
</tr>
</tbody>
</table>

**A3**  Which of the following best describes your current smoking status? (Please tick one response only)

<table>
<thead>
<tr>
<th>I have never smoked</th>
<th>O</th>
</tr>
</thead>
<tbody>
<tr>
<td>I used to smoke</td>
<td>O</td>
</tr>
<tr>
<td>I now smoke occasionally</td>
<td>O</td>
</tr>
<tr>
<td>I now smoke regularly</td>
<td>O</td>
</tr>
</tbody>
</table>

**A4**  Which of the following best describes you at the moment? (Please tick one response only)

| I am actively doing things to try to gain weight at the moment | O |
| I am actively doing things to try to avoid gaining weight at the moment | O |
| I am actively doing things to try to lose weight at the moment | O |
| I am not doing anything in particular for my weight at the moment | O |

**A5**  How often do you weigh yourself? (Please tick one response only)

<table>
<thead>
<tr>
<th>Never</th>
<th>O</th>
</tr>
</thead>
<tbody>
<tr>
<td>About once a year</td>
<td>O</td>
</tr>
<tr>
<td>Every couple of months</td>
<td>O</td>
</tr>
<tr>
<td>Once or twice a month</td>
<td>O</td>
</tr>
<tr>
<td>Once a week</td>
<td>O</td>
</tr>
<tr>
<td>Several times a week</td>
<td>O</td>
</tr>
<tr>
<td>Once a day</td>
<td>O</td>
</tr>
<tr>
<td>More than once a day</td>
<td>O</td>
</tr>
</tbody>
</table>
A6 How much do you currently weigh, without clothes or shoes?
   _____ kg  or  _____ pounds

A7 How tall are you (without shoes)?
   _____cm  or  _____feet  _____inches

A8 Are you currently pregnant? (Please tick one response only)
   Yes  O 1
   No   O 2
   Don’t know  O 3

A9 Have you reached menopause? (Please tick one response only)
   Yes  O 1
   No   O 2
   Don’t know  O 3
Section B: Physical Activity

We are interested in finding out about the kinds of physical activities you do as part of your everyday life. Please answer each question even if you don’t think you are an active person.

Think about all the **vigorous** and **moderate** activities you did in the **last 7 days**.

**Vigorous** physical activities refer to activities that take hard physical effort and make you breathe much harder than normal.

**Moderate** activities refer to activities that take moderate physical effort and make you breathe somewhat harder than normal.

We know that some weeks you might be more active than others. We would still like you to tell us about the physical activity you did in the **LAST 7 DAYS**.

---

**B1**  Do you have a serious illness, long-term injury or disability that prevents you from being **physically active**? (Please tick one response only).

- No  2
- Yes  1

If **YES**, please specify: _____________________________________

---

**B2**  Thinking about how much physical activity you did in the **last 7 days**, was this a typical **week for you**? (Please tick one response only)

- Yes  1
- No, I am usually **more** active  2
- No, I am usually **less** active  3

---

**JOB-RELATED PHYSICAL ACTIVITY**

The first section is about your work. This includes paid jobs, farming, volunteer work, and any other unpaid work you did outside your home. Do not include unpaid work you might do around your home, like housework, yard work, general maintenance, and caring for your family. These are asked in the section on housework and house maintenance later in the survey.

**B3**  Do you currently have a job or do any unpaid work outside your home?

- Yes  1
- No  2

If you answered **NO** → skip to question **B7**
The next questions are about all the physical activity you did in the last 7 days as part of your paid or unpaid work. This does not include travelling to and from work.

Think about only those physical activities that you did for at least 10 minutes at a time.

B4  
a. During the last 7 days, on how many days did you do vigorous physical activities like heavy lifting, digging, heavy construction, or climbing up stairs as part of your work? Think about only those physical activities that you did for at least 10 minutes at a time.

__________ days per week  or  

If you answered NO → skip to question B5

b. How much time did you usually spend on one of those days doing vigorous physical activities as part of your work?

__________hours and __________minutes/day

B5  
a. Again, think about only those physical activities that you did for at least 10 minutes at a time. During the last 7 days, on how many days did you do moderate physical activities like carrying light loads as part of your work? Please do not include walking.

__________ days per week  or  

If you answered NO → skip to question B6

b. How much time did you usually spend on one of those days doing moderate physical activities as part of your work?

__________hours and __________minutes/day
B6  a. During the last 7 days, on how many days did you walk for at least 10 minutes at a time as part of your work? Please do not count any walking you did to travel to or from work.

__________ days per week  or  

If you answered NO → skip to question B7

b. How much time did you usually spend on one of those days walking as part of your work?

__________ hours and __________ minutes/day

TRANSPORTATION PHYSICAL ACTIVITY

These questions are about how you travelled from place to place, including to places like work, shops, movies, and so on.

B7  a. During the last 7 days, on how many days did you bicycle for at least 10 minutes at a time to go from place to place?

__________ days per week  or  

If you answered NO → skip to question B8

b. How much time did you usually spend on one of those days to bicycle from place to place?

__________ hours and __________ minutes/day

B8  a. During the last 7 days, on how many days did you walk for at least 10 minutes at a time to go from place to place?

__________ days per week  or  

If you answered NO → skip to question B9

b. How much time did you usually spend on one of those days walking from place to place?

__________ hours and __________ minutes/day
**HOUSEWORK AND HOUSE MAINTENANCE**

This section is about some of the physical activities you might have done in the **last 7 days** in and around your home, like housework, gardening, yard work, general maintenance work, and caring for your family.

**B9**

a. Think about *only* those physical activities that you did for at least **10 minutes** at a time. During the **last 7 days**, on how many days did you do **vigorous** physical activities like heavy lifting, chopping wood, shoveling, or digging in the garden or yard?

__________ days per week  

or  

No days per week  

If you answered NO → skip to question B10

b. How much time in total did you usually spend on one of those days doing vigorous physical activities in the garden or yard?

__________ hours and __________ minutes/day

**B10**

a. Again, think about *only* those physical activities that you did for at least **10 minutes** at a time. During the **last 7 days**, on how many days did you do **moderate** activities like carrying light loads, sweeping, washing windows, and raking in the garden or yard?

__________ days per week  

or  

No days per week  

If you answered NO → skip to question B11

b. How much time in total did you usually spend on one of those days doing moderate physical activities in the garden or yard?

__________ hours and __________ minutes/day

**B11**

a. Again, think about *only* those physical activities that you did for at least **10 minutes** at a time. During the **last 7 days**, on how many days did you do **moderate** activities like carrying light loads, washing windows, scrubbing floors and sweeping inside your home?

__________ days per week  

or  

No days per week  

If you answered NO → skip to question B12

b. How much time did you usually spend on one of those days doing moderate physical activities inside your home?

__________ hours and __________ minutes/day
RECREATION, SPORT, AND LEISURE-TIME PHYSICAL ACTIVITY

This section is about all the physical activities that you did in the last 7 days solely for recreation, sport, exercise or leisure. Please do not include any activities you have already mentioned.

B12  a. Not counting any walking you have already mentioned, during the last 7 days, on how many days did you walk for at least 10 minutes at a time in your leisure time?

__________ days per week or No days per week  ○ 0

If you answered NO → skip to question B13

b. How much time did you usually spend on one of those days walking in your leisure time?

__________ hours and __________ minutes/day

B13  a. Think about only those physical activities that you did for at least 10 minutes at a time. During the last 7 days, on how many days did you do vigorous physical activities like aerobics, running, fast bicycling, or fast swimming in your leisure time?

__________ days per week or No days per week  ○ 0

If you answered NO → skip to question B14

b. How much time did you usually spend on one of those days doing vigorous physical activities in your leisure time?

__________ hours and __________ minutes/day

B14  a. Think about only those physical activities that you did for at least 10 minutes at a time. During the last 7 days, on how many days did you do moderate physical activities like bicycling at a regular pace, swimming at a regular pace, and doubles tennis in your leisure time?

__________ days per week or No days per week  ○ 0

If you answered NO → skip to question B15

you answered

NO → skip to question B15
b. How much time did you usually spend on one of those days doing moderate physical activities in your leisure time?

_________ hours and _________ minutes/day

B15 Thinking about all of your walking, moderate and vigorous leisure-time physical activity in the last 7 days, about how much of this was done ON YOUR OWN (as opposed to with someone else like family, friend or in an exercise group or class)? (Please tick one response only)

<table>
<thead>
<tr>
<th>Response Description</th>
<th>Option</th>
</tr>
</thead>
<tbody>
<tr>
<td>I did not participate in any leisure-time physical activity</td>
<td>1</td>
</tr>
<tr>
<td>All of this leisure-time physical activity was done on my own</td>
<td>2</td>
</tr>
<tr>
<td>Most (about ¾) of this leisure-time physical activity was done on my own</td>
<td>3</td>
</tr>
<tr>
<td>About half of this leisure-time physical activity was done on my own</td>
<td>4</td>
</tr>
<tr>
<td>A little of (about ¼) of this leisure-time physical activity was done on my own</td>
<td>5</td>
</tr>
<tr>
<td>None of this leisure-time physical activity was done on my own</td>
<td>6</td>
</tr>
</tbody>
</table>

TIME SPENT SITTING

The next questions are about the time you spend sitting while at work, at home, while doing study, and during leisure time. This may include time spent sitting at a desk, visiting friends, reading or sitting or lying down to watch television or sitting in a motor vehicle.

B16 a. During the last 7 days, how much time did you usually spend sitting on a weekday (INCLUDING the day and evening)?

_________ hours and _________ minutes/weekday

b. During the last 7 days, how much time did you usually spend sitting on a weekend day (INCLUDING the day and evening)?

_________ hours and _________ minutes/weekend day
In the times you spent sitting, we are interested in finding out the types of activities you did.

B17  

a. Of your total sitting time, during the last 7 days, how much time did you usually spend sitting watching TV on a weekday?

__________hours and __________minutes/weekday

b. Of your total sitting time, during the last 7 days, how much time did you usually spend sitting watching TV on a weekend day?

__________hours and __________minutes/weekend day

B18  

a. Of your total sitting time, during the last 7 days, how much time did you usually spend sitting at a computer on a weekday?

__________hours and __________minutes/weekday

b. Of your total sitting time, during the last 7 days, how much time did you usually spend sitting at a computer on a weekend day?

__________hours and __________minutes/weekend day

B19  
Are you a member of a sporting, exercise or outdoor recreational group or club? (Please tick one response only)

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>O</td>
</tr>
<tr>
<td>No</td>
<td>O</td>
</tr>
</tbody>
</table>
Below is a list of ways you might have felt or behaved. For each statement, please circle the answer that indicates how often you have felt this way during the past week. (Please circle one response on each line)

<table>
<thead>
<tr>
<th>Statement</th>
<th>Rarely or none of the time</th>
<th>Some or little of the time</th>
<th>Occasionally or a moderate amount of the time</th>
<th>Most or all of the time</th>
</tr>
</thead>
<tbody>
<tr>
<td>I was bothered by things that usually don’t bother me</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I had trouble keeping my mind on what I was doing</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I felt depressed</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I felt that everything I did was an effort</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I felt hopeful about the future</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I felt fearful</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>My sleep was restless</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I was happy</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I felt lonely</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I could not get “going”</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

You are on the home stretch now!

😊

Just a few more questions about you.
Section E: About You

E1 What is your date of birth? (Please write on the line)

_____ / _____ / 19____ (dd/mm/19yy)

E2 What is today’s date? (Please write on the line)

_____ / _____ / _____ (dd/mm/yyyy)

E3 What is your HOME address? This may be different to your postal address. We ask for this information because we would like to find out how far it is for you to get to local facilities and services such as parks, shopping centres and food outlets.

__________________________________________
(house/unit number)    (street name)

__________________________________________
(suburb)              (postcode)

E4 What is your POSTAL address? This may be different to your home address.
(If this is the same as your home address, please write “as above”)

__________________________________________
__________________________________________

E5 In which country were you born? (Please tick one response only)

Australia  ○ 1
UK          ○ 2
Italy       ○ 3
Greece      ○ 4
New Zealand ○ 5
Vietnam     ○ 6
Other       ○ 7
E6  In your household, do you usually speak English? (Please tick one response only)

Yes  1
No  2

E7  Which of the following best describes your current relationship status? (Please tick one response only)

Living in a registered marriage  1
Living in a de facto relationship  2
Separated  3
Divorced  4
Widowed  5
Never married  6

E8  What is the HIGHEST qualification you, and your spouse/partner if applicable, have completed? (Please tick one response in each column: one for you, and one for your spouse/partner. If you do not have a spouse/partner please tick that response below).

<table>
<thead>
<tr>
<th>Qualification</th>
<th>Self a</th>
<th>Spouse/ Partner b</th>
</tr>
</thead>
<tbody>
<tr>
<td>No formal qualifications</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Year 10 or equivalent (e.g. School Certificate)</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Year 12 or equivalent (e.g. Higher School Certificate)</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Trade/apprenticeship (e.g. hairdresser, chef)</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>Certificate/diploma (e.g. childcare, technician)</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>University degree</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>Higher University degree (e.g. Graduate Diploma, Masters, PhD)</td>
<td>7</td>
<td>2</td>
</tr>
<tr>
<td>I do not have a spouse/partner</td>
<td>8</td>
<td>8</td>
</tr>
</tbody>
</table>
Which of the following BEST describes your current MAIN DAILY activities and/or responsibilities, and those of your spouse/partner? (Please tick one response in each column: one for you, and one for your spouse/partner. If you do not have a spouse/partner please tick that response below).

<table>
<thead>
<tr>
<th></th>
<th>Self</th>
<th>Spouse/ Partner</th>
</tr>
</thead>
<tbody>
<tr>
<td>Working full-time</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Working part-time</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Unemployed or laid off</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Keeping house and/or raising children full-time</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>Studying full-time</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>Retired</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>I do not have a spouse/partner</td>
<td>7</td>
<td></td>
</tr>
</tbody>
</table>

If you do paid work, how many hours did you spend in your paid job(s) in total in the last week? (Please tick one response only).

<p>| | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>I didn’t do any paid work</td>
<td>1</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>1-15 hours</td>
<td>2</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>16-24 hours</td>
<td>3</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>25-34 hours</td>
<td>4</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>35-40 hours</td>
<td>5</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>41-48 hours</td>
<td>6</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>49 hours or more</td>
<td>7</td>
<td>7</td>
<td></td>
</tr>
</tbody>
</table>

If NO PAID WORK→skip to question E12

If you do paid work, how often does this involve working night or weekend shifts? (Please only tick one response for nights and one response for weekends).

<table>
<thead>
<tr>
<th></th>
<th>Night Shifts</th>
<th>Weekend Shifts</th>
</tr>
</thead>
<tbody>
<tr>
<td>Never</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Sometimes</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Often</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Always</td>
<td>4</td>
<td>4</td>
</tr>
</tbody>
</table>
The following question asks about your household income.

This is an important question because household income is known to have an influence on people’s health.

E12  What is the average gross (before tax) income that you and your household receive each WEEK, including wages, salary, pensions and allowances?  (Please tick one response in each column: one for yourself and one for your household)

<table>
<thead>
<tr>
<th>Self a</th>
<th>Household b</th>
</tr>
</thead>
<tbody>
<tr>
<td>No income</td>
<td>1</td>
</tr>
<tr>
<td>$1-$119 per week ($1-$6,239 annually)</td>
<td>2</td>
</tr>
<tr>
<td>$120-$299 per week ($6,240-$15,999 annually)</td>
<td>3</td>
</tr>
<tr>
<td>$300-$499 per week ($16,000-$25,999 annually)</td>
<td>4</td>
</tr>
<tr>
<td>$500-$699 per week ($26,000-$36,999 annually)</td>
<td>5</td>
</tr>
<tr>
<td>$700-$999 per week ($37,000-$51,999 annually)</td>
<td>6</td>
</tr>
<tr>
<td>$1,000-$1,499 per week ($52,000-$77,999 annually)</td>
<td>7</td>
</tr>
<tr>
<td>$1,500 or more per week ($78,000 or more annually)</td>
<td>8</td>
</tr>
<tr>
<td>Don’t know</td>
<td>9</td>
</tr>
<tr>
<td>Don’t want to answer</td>
<td>10</td>
</tr>
<tr>
<td>Household income is the same as mine</td>
<td>11</td>
</tr>
</tbody>
</table>

E13  How many people (including yourself) are dependent on this household income?  (Please tick one response only).

| One (self) | 1 |
| Two | 2 |
| Three | 3 |
| Four | 4 |
| Five | 5 |
| Six or more | 6 |

E14  At the place where you now live, are you:  (Please tick one response only)

| An owner (No mortgage) | 1 |
| A purchaser (Paying mortgage) | 2 |
| A renter | 3 |
| Living rent-free | 4 |
| A boarder | 5 |
E15  Do you have access to a motor vehicle for private use whenever you need it?  (Please tick one response only).

Yes  
No  

E16  Do you own a dog?  (Please tick one response only).

Yes  
No  

E17  Please tell us about your yard.  We have:  (Please tick one response only)

No yard at all  
No private yard  
A small yard (e.g. unit)  
A medium yard (e.g. standard block of land)  
A large yard (e.g. ¼ acre to 1 acre)  
A property between 2 acres and 10 acres  
A property larger than 10 acres  

E18  How many televisions do you have in your house?  (Please tick one response only)

None  
One  
Two  
Three  
Four or more  

E19  Have you ever given birth to a child?  (Please tick one response only)

Yes  
No  

If NO→skip to question E21
## E20 How old were you when you had your children?

<table>
<thead>
<tr>
<th>Question</th>
<th>Please specify in years</th>
<th>Not applicable</th>
</tr>
</thead>
<tbody>
<tr>
<td>How old were you when you had your <strong>first</strong> child?</td>
<td>_______ years old</td>
<td>O₁</td>
</tr>
<tr>
<td>How old were you when you had your <strong>second</strong> child?</td>
<td>_______ years old</td>
<td>O₁</td>
</tr>
<tr>
<td>How old were you when you had your <strong>third</strong> child?</td>
<td>_______ years old</td>
<td>O₁</td>
</tr>
<tr>
<td>How old were you when you had your <strong>fourth</strong> child?</td>
<td>_______ years old</td>
<td>O₁</td>
</tr>
<tr>
<td>How old were you when you had your <strong>fifth</strong> child?</td>
<td>_______ years old</td>
<td>O₁</td>
</tr>
<tr>
<td>How old were you when you had your <strong>sixth</strong> child?</td>
<td>_______ years old</td>
<td>O₁</td>
</tr>
</tbody>
</table>

## E21 Are there any children living with you now? (Please tick one response only)

<table>
<thead>
<tr>
<th>Response</th>
<th>O₁</th>
<th>O₂</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>No</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

If **NO** → skip to the last page

## E22 How many children live with you now? (Please circle all that apply).

<table>
<thead>
<tr>
<th>Age Group</th>
<th>None₁</th>
<th>One₂</th>
<th>Two₃</th>
<th>Three or more₄</th>
</tr>
</thead>
<tbody>
<tr>
<td>Children under 2 years</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Children between 2 and 4 years</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Children between 5 and 12 years</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Children between 13 and 18 years</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Appendix 6

Initial letter of correspondence for Study 2
(Study of the Influences on Women’s Physical Activity and Mood)
Dear <<PARTICIPANT FIRST NAME>>,

My name is Megan Teychenne, I am a PhD student in the School of Exercise and Nutrition Sciences at Deakin University. I am conducting a research project that examines women’s influences on physical activity and sedentary behaviours (eg. television viewing, sitting at the computer). I am particularly interested in speaking with women who may be feeling stressed or feeling down as research has found physical activity to be a great benefit to those feelings. This research seeks to better understand the various influences and identify strategies that may help in promoting healthy behaviours such as physical activity to women. Your name was selected from the Women’s Health Study you took part in during 2007/2008. In that study, many women including you indicated that they felt their sleep was restless and/or they were bothered by things that don’t usually bother them at the time of completing the questionnaire. These can often be signs of stress or feeling down. You also indicated that you were interested in taking part in further research. I would now like to invite you to participate in this additional study.

If you would like to take part in this research I will ask that you to take part in a one-on-one telephone interview. The interview will take approximately 20 minutes. I am interested in the factors may influence your physical activity. With your permission, the interview would be tape-recorded so that we can make sure we that we have an accurate record of what you say. I will be monitoring that the research is being carried out ethically. You will not be paid for your participation in this project. However, we would like to offer you a $20 Coles Myer gift voucher in appreciation of your time.

Please be assured that we will protect your anonymity and the confidentiality of your involvement in the telephone interview to the fullest possible extent. If at any time during the interview you feel uncomfortable you may withdraw from the study. The results of this study will be reported as group data only. Your individual information will not be identifiable in the report, it will be held in confidence and will be stored securely at Deakin University. All
information will be used for research purposes only. Once the research has been completed (estimated to be October 2009), a brief summary of the findings will be mailed to you (if you indicate you would like this when asked at the conclusion of the interview). The results will be presented at academic conferences and published in academic journals, but these will never identify any individual participant. Only members of the research team will have access to your personal contact details.

A reply-paid slip has been provided for you to indicate whether you are interested in discussing the research project further with the researcher. If you indicate that you would like to discuss the research project further, you will receive a phone call from me in 1-2 week’s time. This is an important research study, but please know that your participation in this study is completely voluntary. I am available to answer any questions you have about the research project, either by phone or email.

If you have any complaints about any aspect of the project, the way it is being conducted or any questions about your rights as a research participant, then you may contact: Manager, Research Integrity, Deakin University, 221 Burwood Highway, Burwood Victoria 3125, Telephone: 9721 7129, Facsimile: 9244 6581; research-ethics@deakin.edu.au. Please quote project number EC 55-2009.

**If you have any questions regarding this study, please don’t hesitate to contact me by telephoning 03 9251 7262 between 9am and 5pm weekdays or emailing mteych@deakin.edu.au** Your participation is very important, and by telling us about your experiences and thoughts you will help add to our knowledge of how we can promote physical activity to women.

Thank you,

Ms Megan Teychenne, PhD Student, School of Exercise & Nutrition Sciences, Deakin University, Burwood
Appendix 7

Reply-paid slip indicating interest in participation for Study 2
Please tick one of the following boxes and return in the reply paid envelope provided.

☐ I am interested in discussing the research project *Study of the influences on women’s physical activity and mood* further with the researcher.

☐ I do not wish to be contacted in regards to the research project *Study of the influences on women’s physical activity and mood*.

Name: _____________________________________________

Phone no: ____________________ or ____________________

* Please note: If you agree to be contacted you are still able to decline to participate when the researcher calls if it doesn’t suit you at that time.
Appendix 8

Reminder letter for Study 2
Dear Madam,

Re: Research Study

A few weeks ago I sent you a letter seeking your interest in participating in a one-on-one telephone interview, which will discuss women’s influences on physical activity and sedentary behaviours. This study will provide important information about how we can promote women’s physical activity and overall health.

If you have already returned the reply-paid slip, please accept my sincere thanks. If not, I would be grateful if you would do so as soon as you can.

In the event that your reply-paid slip has been misplaced, a replacement is enclosed. If you have any questions regarding this study please do not hesitate to contact me on (03) 9251 7262 between 9am and 5pm on weekdays.

Yours sincerely,

Ms Megan Teychenne, PhD Student, School of Exercise & Nutrition Sciences, Deakin University, Burwood
Appendix 9

Centre for Epidemiologic Studies Short Depression Scale (CES-D 10)
STUDY OF THE INFLUENCES ON WOMEN'S PHYSICAL ACTIVITY AND MOOD

Centre for Epidemiologic Studies Short Depression Scale (CES-D 10)

Below is a list of some of the ways you may have felt or behaved. Please indicate how often you have felt this way during the past week: (circle one number on each line)

During the past week...

<table>
<thead>
<tr>
<th></th>
<th>Rarely/none of the time (less than 1 day)</th>
<th>Some/a little of the time (1-2 days)</th>
<th>Occasionally/moderate amount of the time (3-4 days)</th>
<th>All of the time (5-7 days)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>I was bothered by things that usually don’t bother me</td>
<td>0</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>2</td>
<td>I had trouble keeping my mind on what I was doing</td>
<td>0</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>3</td>
<td>I felt depressed</td>
<td>0</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>4</td>
<td>I felt that everything I did was an effort</td>
<td>0</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>5</td>
<td>I felt hopeful about the future</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>6</td>
<td>I felt fearful</td>
<td>0</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>7</td>
<td>My sleep was restless</td>
<td>0</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>8</td>
<td>I was happy</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>9</td>
<td>I felt lonely</td>
<td>0</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>10</td>
<td>I could not “get going”</td>
<td>0</td>
<td>1</td>
<td>2</td>
</tr>
</tbody>
</table>

Score >=10 indicates participant is experiencing depressive symptoms/at risk of depression

Score [ ] Participant at risk of depression/eligible? [ ]

Consent form x 2/confirmation letter/PLS (& reply paid) sent: [ ]

Consent form received: [ ]

Date & time for telephone interview: (date) (time)

Notes: ____________________________________________________________
Appendix 10

Plain language statement and consent form for Study 2
PLAIN LANGUAGE STATEMENT AND CONSENT FORM TEMPLATE FOR NON-CLINICAL RESEARCH PROJECTS

Using this template

1. Recommended text is in plain type.

2. Instructions for preparation of the document are in *bold, italic type*. You should delete these comments from the final document.

3. Please delete any sections or statements that are not relevant to your research project.

4. Any relevant information not included in this template which is essential for the participants to give fully informed consent should be added as necessary.

5. For all student projects (undergraduate and postgraduate), please note that the Principal Researcher is always the Supervisor.

6. Each page of the Plain Language Statement and Consent Form must be numbered using the format ‘Page x of y’ and you must also include who the PLS and Consent is going to in the footer.

7. The Consent Form must always be attached to the Plain Language Statement and a copy of the entire document must be given to participants (and organisations or parents if relevant etc). Delete unnecessary Consent Forms.

8. If other Human Research Ethics Committees (HRECs) are involved, please check with the relevant HREC for any site-specific requirements and their standard wording for Plain Language Statements if required. For example, a clause concerning risks to pregnancy while participating in a research project may be relevant.

9. For participants aged less than 18 years, please provide the Plain Language Statement in words that will be understood by the age group.

Please note: According to the *National Statement on Ethical Conduct in Human Research (2007)* Chapter 3.3, ‘a clinical trial is a form of human research designed to find out the effects of an intervention, including a treatment or diagnostic procedure. A clinical trial can involve testing a drug, a surgical procedure, other therapeutic procedures and devices, a preventive procedure, or a diagnostic device or procedure’.

For projects involving clinical trials, researchers should use the template provided specifically for such projects.
TO: Participant

Plain Language Statement

Date:

Full Project Title: Study of the influences on women’s physical activity and mood

Principal Researcher: Associate Professor Kylie Ball

Student Researcher: Ms Megan Teychenne

Associate Researcher(s): Associate Professor Jo Salmon

This Plain Language Statement and Consent Form is 5 pages long. Please make sure you have all the pages.

1. Your Consent

You are invited to take part in this research project. This is a follow-on study from the Women’s Health Study which you participated in during 2007/2008.

This Plain Language Statement contains detailed information about the research project. Its purpose is to explain to you as openly and clearly as possible all the procedures involved in this project so that you can make a fully informed decision whether you are going to participate.

Please read this Plain Language Statement carefully. Feel free to ask questions about any information in the document. You may also wish to discuss the project with a relative or friend or your local health worker. Feel free to do this.

Once you understand what the project is about and if you agree to take part in it, you will be asked to sign the Consent Form. By signing the Consent Form, you indicate that you understand the information and that you give your consent to participate in the research project.

You will be given a copy of the Plain Language Statement and Consent Form to keep as a record.

2. Purpose and Background

The purpose of this project is to examine the influences on physical activity and sedentary behaviour (eg. TV viewing) in women who may be feeling stressed or feeling down. This research will contribute towards Megan Teychenne achieving her PhD qualification.

A total of 30 people will participate in this project.

Previous research has shown physical activity to have great health benefits as well as helping you to feel good and reduce feelings of stress. As women are at a greater risk than men of not doing enough physical activity, they are an important target group for promoting physical activity.

You are invited to participate in this research project as your name was selected from the Women’s Health Study you took part in during 2007/2008. In that study, many women including you indicated that they felt their sleep was restless, and/or that they were bothered by things that don’t usually bother them, at the time of completing the questionnaire. These can often be signs of stress or feeling
down. You also indicated that you were interested in taking part in further research. Your involvement would be appreciated as we hope to learn more about what influences women’s physical activity. This information is important as it will help us develop strategies and programs to promote physical activity to women.

3. Procedures
Participation in this project will involve a one-on-one telephone interview that will take approximately 20 minutes. During the interview we will talk about a variety of factors that may influence your participation in physical activity. This may include discussion about what types of physical activity you do during leisure-time as well as the barriers that prevent you from being active. With your permission, the interview will be audio-taped, and the key points recorded in writing. Please be assured that all information will remain confidential and will be used for research purposes only. You will be given a $20 Coles Myer gift voucher in appreciation of your time.

4. Possible Benefits
While you will be provided with a gift voucher, we cannot guarantee or promise that you will receive any other benefits from this project.

5. Possible Risks
In the case that you may experience any distress, a referral to counselling, such as Beyondblue, Lifeline, or a local GP independent of the research, will be made available. If you agree to participate, you are free to withdraw at any time in which your participation will be immediately ceased and any information obtained from you will not be used.

6. Privacy, Confidentiality and Disclosure of Information
Please be assured that all the information you provide will remain completely anonymous and will remain confidential. It will be stored securely for a period of 6 years from the date of publication and then destroyed. All identifying information will be held in separate locked cabinets. Only those researchers working on the study will have access to the data. The results from the study may be presented at academic conferences and published in academic journals; however, you will not be identified at any time.

7. Results of Project
At the end of the study (approximately October 2009) we will send you a short summary of the overall findings if you would like to receive it. You can indicate whether you would like to receive the summary when asked at the conclusion of your interview.

8. Participation is Voluntary
Participation in any research project is voluntary. If you do not wish to take part you are not obliged to. If you decide to take part and later change your mind, you are free to withdraw from the project at any stage. Any information obtained from you to date will not be used and will be destroyed.

Your decision whether to take part or not to take part, or to take part and then withdraw, will not affect your relationship with Deakin University.

Before you make your decision, a member of the research team will be available to answer any questions you have about the research project. You can ask for any information you want. Sign the Consent Form only after you have had a chance to ask your questions and have received satisfactory answers.
If you decide to withdraw from this project, please notify a member of the research team or complete and return the Revocation of Consent Form attached. This notice will allow the research team to inform you if there are any health risks or special requirements linked to withdrawing.

9. Ethical Guidelines
This project will be carried out according to the National Statement on Ethical Conduct in Human Research (2007) produced by the National Health and Medical Research Council of Australia. This statement has been developed to protect the interests of people who agree to participate in human research studies.

The ethics aspects of this research project have been approved by the Human Research Ethics Committee of Deakin University.

10. Complaints
If you have any complaints about any aspect of the project, the way it is being conducted or any questions about your rights as a research participant, then you may contact:

Manager, Research Integrity, Deakin University, 221 Burwood Highway, Burwood Victoria 3125, Telephone: 9721 7129, Facsimile: 9244 6581; research-ethics@deakin.edu.au.

Please quote project number EC 55-2009.

11. Reimbursement for your costs
You will not be paid for your participation in this project. However, you will be given a $20 Coles Myer gift voucher in appreciation of your time.

12. Further Information, Queries or Any Problems
If you require further information, wish to withdraw your participation or if you have any problems concerning this project (for example, any side effects), you can contact the principal researcher or associate researchers.

The researchers responsible for this project are:

A/Prof Kylie Ball
Principal Researcher
School of Exercise & Nutrition Sciences
Deakin University
221 Burwood Hwy Burwood
(03) 9251 7310
kball@deakin.edu.au

Ms Megan Teychenne
Associate Researcher
School of Exercise & Nutrition Sciences
Deakin University
221 Burwood Hwy Burwood
(03) 9251 7262
mteych@deakin.edu.au

A/Prof Jo Salmon
Associate Researcher
School of Exercise & Nutrition Sciences
Deakin University
221 Burwood Hwy Burwood
(03) 9251 7254
jo.salmon@deakin.edu.au

A/Prof Jo Salmon
Associate Researcher
School of Exercise & Nutrition Sciences
Deakin University
221 Burwood Hwy Burwood
(03) 9251 7254
jo.salmon@deakin.edu.au
Consent Form

Date:

Full Project Title: Study of the influences on women's physical activity and mood

I have read and I understand the attached Plain Language Statement.

I freely agree to participate in this project according to the conditions in the Plain Language Statement.

I have been given a copy of the Plain Language Statement and Consent Form to keep.

The researcher has agreed not to reveal my identity and personal details, including where information about this project is published, or presented in any public form.

Participant's Name (printed) ……………………………………………………………………

Signature ……………………………………………………… Date  …………………………

Ms Megan Teychenne
Associate Researcher
School of Exercise & Nutrition Sciences
Deakin University
221 Burwood Hwy Burwood
Ph: (03) 9251 7262
Fax: (03) 9244 6017
mteych@deakin.edu.au
Revocation of Consent Form

(To be used for participants who wish to withdraw from the project)

Date:

Full Project Title: Study of the influences on women’s physical activity and mood

I hereby wish to WITHDRAW my consent to participate in the above research project and understand that such withdrawal WILL NOT jeopardise my relationship with Deakin University.

Participant’s Name (printed) ……………………………………………………..

Signature ………………………………………………………………………….. Date ……………………

Please mail or fax this form to:

Ms Megan Teychenne
Associate Researcher
School of Exercise & Nutrition Sciences
Deakin University
221 Burwood Hwy Burwood
Ph: (03) 9251 7262
Fax: (03) 9244 6017
mteych@deakin.edu.au
Appendix 11

Interview Schedule for Study 2
STUDY OF THE INFLUENCES ON WOMEN'S PHYSICAL ACTIVITY AND MOOD

INTERVIEW SCHEDULE: (25 mins)
- Participants advised there are no right or wrong responses to any questions asked
- Re-iterate from PLS: All contributions are confidential.
  Interview will be tape-recorded (with permission from participant)
- Ask participant if they have any questions before you start
- Researcher will ask participant a little bit about themselves eg. Where do they live? Work?

Discussion questions:
PA can refer to activity that is done for leisure/recreation, work, domestic and transport. Today we will mainly discuss LTPA and the personal, social and environmental factors that may influence your LTPA.

**LTPA:**
1. Do you do LTPA? (if not, why not?)
2. How much time do you spend undertaking PA in leisure-time? *(days/time).* What reasons do you do LTPA?
3. What types of activities do you undertake? (eg. walking, sports, cycling)
4. Do you enjoy doing these activities?
5. How do these activities make you feel? *(physically? mentally? Emotionally?)*
6. Would you like to do more activity during LT? If yes, what are the reasons that are stopping you from being as active as you like? *(time constraints, stress, inflexible working hours, lack of money, lack of transport?)*

**Intra-personal factors (PA)**
7. Some women say childhood PA is an influence on their LTPA as an adult. Do you think your experiences with physical activity as a child have influenced you? How?
8. Does feeling tired impact on your physical activity? *(LT/work/transport)* If so, how?
9. Does feeling stressed impact on your physical activity *(LT/work/transport)*? If so, how?
10. Would you ever think to do PA to reduce feelings of stress?
11. How feasible do you think it would be for you to be active even when you’re feeling tired or stressed? Why/why not?
12. Does not feeling well impact on your physical activity? If so, how?

**Social factors (PA)**
13. *[If participant has children]* How does having kids impact on your LTPA? If so, how?
14. Do you do any LTPA with a friend or Team?
15. Who? *(family/friend/colleagues)*
16. Do you enjoy social physical activities more or individual? What differences do you see?
17. How active would you say your family are? Partner? Friends? People at work?
18. Do they encourage you to be active? Discourage?
19. In what ways would their PA influence yours? (E.g. If they are active would this influence you to be active?)
20. How feasible do you think it would be for you to be active with a friend? Why/why not?

Physical environmental factors (PA)
22. Thinking about those places, what things do you think are important for you to be active? (E.g. undercover? Safe? Location? Cost? Scenic?)
23. How feasible do you think it would be for you to be physically active, even if it took 20 minutes to get to good facilities? (eg. gym/walking track) Why/why not?
24. How much money would you be willing to pay per week for exercise facilities/classes?
25. What do you think would help you be more physically active around your neighbourhood? Eg. better facilities, well lit streets/walking paths, cycle track, transport?Childcare?
26. If the weather is bad, does this impact on your PA? If so, how?
27. How feasible do you think it would be for you to do PA even when the weather is bad? Why/why not?

LTPA and direction of feelings
28. If you’re feeling down, does that impact on your LTPA? If so, how? (do more, less, same?)
29. Would you ever think to do LTPA to improve your mood when you feel down?
30. What’s the one thing that would most help you be more active when you’re feeling down?

Other PA domains and direction of feelings
31. Do you do any work, transport or domestic PA?
32. If you’re feeling down, does that impact on your domestic/work/transport PA? If so, how? (do more, less, same?)
33. How does domestic/work/transport PA make you feel emotionally and mentally?

Now I would like to discuss your sedentary behaviour. This means activities you do when sitting eg. TV viewing, sitting at the computer, driving, reading etc.

Sedentary behaviour
34. How much of the week day would you spend… watching TV? Sitting at the computer? Sitting while driving? (Work versus home)
35. How does watching TV/computer make you feel? Home versus work? (Physically and mentally?)
**Intra-personal factors (SB)**

36. When you’re at home (eg. home from work), what would you say would be the main activity you do? Eg. TV, computer? Read? or Cook? Clean?
37. What are the main reasons you watch TV? (enjoyment/tired?)
38. What are the main reasons you sit at the computer? (enjoyment? Work? Social?)
39. How feasible do you think it would be for you to turn the TV off even when you’re feeling tired? Why/why not?
40. Does feeling stressed impact on your SB….TV/computer? If so, how? Does it make you feel better?
41. How feasible do you think it would be for you to turn the TV off even when you’re feeling stressed? Why/why not?
42. Does PA impact on how much TV you watch? If so, how? Eg. if you go for a walk are you less inclined to sit and watch TV for the rest of the night or more inclined?
43. Does your diet impact on the amount of TV you watch? If so, how?
44. Has your childhood TV habits impacted on your adulthood TV habits? If so, how?

**Social factors (SB)**

45. Do your friends/family influence you to watch TV? Go on the computer? If so, how?
46. Do they ever discourage/(encourage) you from watching TV? Computer?
47. How feasible do you think it would be for you not watch TV at night, even when your family are? Why/why not?
48. [If participant has children] Does having children impact on the time you spend sitting? If so, how?

**Physical-environmental factors (SB)**

49. How would “standing up” whilst watching TV impact on the time you spend watching TV?
50. How would “standing up” whilst on the computer impact on the time you spend on there?
51. Would you ever consider doing this/How feasible is this? Why/why not?
52. If the weather is nice, does that impact on the amount of time you spend watching TV? Sitting at the computer? Drive in your car? If so, how?
53. How feasible do you think it would be for you to turn the TV off, even when the weather is bad? Why/why not?
54. Does the neighbourhood environment impact on the time you spend sitting watching TV/computer? If so, how? (Does having nice scenery motivate you to go outside and turn off TV even if your favourite TV program is on?)
55. How many TV’s do you own?

**SB direction of feelings**

56. Does feeling down impact on your SB..TV/computer/work versus leisure? If so, how? Do more, less, same? How does it make you feel?
57. How feasible do you think it would be for you to turn the TV off when you’re feeling down? Why/why not?
58. What is the one thing that would most help you to not sit and watch TV/computer when you’re feeling down?

Conclusion
59. Do you have any other ideas on how we can get women active and reduce the time they spend sitting?
60. Finally, just for demographic purposes, can I ask your date of birth? And occupational status? Eg. Working full-time, part-time, retired? Student? Unemployed? Home duties/children full-time?
61. Do you have any final questions?

End recording.

Thank-you for giving up your time to speak to me today. It is much appreciated and has been very helpful to this research project. Would you like to be sent a copy of the general results? (Y/N) [If ‘yes’, explain that they will be sent in October 2009]. I’ll be sending you a gift voucher in appreciation of your time. Also, although not by all means a clinical diagnoses, your score on the CES-D (depressive symptom checklist) did indicate that you were experiencing some symptoms of depression. Therefore, ethically I do have to provide you with contact information for support organisations. Would you like these details?

www.beyondblue.org.au (ph. 1300224636)
Appendix 12

Thank-you letter to participants for Study 2
Dear [Participant],

Thank-you for participating in ‘The study of the influences on women’s physical activity and mood’. Your involvement was greatly appreciated and has contributed to further insights into the factors that influence women’s physical activity and sedentary behaviour.

As a token of our appreciation for your time, a $20 coles-myer voucher is enclosed.

A summary of the results of the study will be sent to you shortly. If you do not wish to receive this please contact me by telephone 03 9251 7262 or by e-mail mteych@deakin.edu.au.

Kind regards,

Ms Megan Teychenne
PhD student/Project manager
Appendix 13

Letter of results for Study 2
Dear Madam,

A few months ago you participated in a telephone interview as a part of the ‘Study of the influences on women’s physical activity and mood’. A total of 18 women participated in this study, providing many interesting insights. Enclosed is a summary of the results from the study for your own interest.

If you have any further questions please contact me on (03) 9251 7262 or mteych@deakin.edu.au.

Many thanks again for participating in this study. Your contribution to this research has been most valuable and will help in the development of programs to increase physical activity, reduce sedentary behaviour and in turn reduce depressive symptoms among women.

Yours sincerely,

Ms Megan Teychenne, PhD Student, School of Exercise & Nutrition Sciences, Deakin University, Burwood
STUDY OF THE INFLUENCES ON WOMEN’S PHYSICAL ACTIVITY AND MOOD

Summary of Results

Influences on physical activity

Many women found it difficult to be physically active for leisure when feeling down. However, most women recognised the impact exercising had on lifting their mood and managing depressive symptoms.

Time constraints (due to work and family responsibilities) was the most common barrier to being physically active mentioned by women.

Other commonly expressed barriers to physical activity:
- Having children/lack of childcare
- Feeling tired
- Cost
- Safety in neighbourhood
- Negative atmospheres of recreational clubs
- Accessibility to recreational facilities

Social physical activities (e.g. walking with a friend) were considered to be more enjoyable and motivating than individual physical activities.

Influences on sedentary behaviour (e.g. TV viewing)

Many women mentioned using TV as a tool to 'switch off' when feeling down.

Multi-tasking was a strategy most women used to reduce the time they spend sitting when watching TV (e.g. watching TV whilst ironing or cooking).

Several women suggested that childhood TV habits influenced their adult TV habits as women mentioned that being restricted by their parents as a child has influenced them now as an adult to watch less television.

Mothers mentioned that having young children caused them to watch lower levels of television. Reasons for this included having a lack of time to sit and watch television as well as positive role modelling for their children.
Potential strategies to increase physical activity and reduce sedentary behaviour

Women mentioned a variety of potential strategies that may be used to increase physical activity and reduce sedentary behaviour. Potential strategies included:

- Public awareness campaigns (to increase knowledge of the physical and mental health benefits of physical activity)
- Time management and multi-tasking
- Childcare facilities (e.g. more 1 hour care facilities)
- Family and friend support
- Mothers exercise groups
- Provision of information on available facilities in the neighbourhood
- Variety of classes/facilities or longer opening hours of facilities
- Women’s only gyms/exercise classes
Appendix 14

Questionnaire for Study 4
(The Women’s Activity Study)
The Women’s Activity Study
2010
Thank you for taking the time to complete this survey. It will take you approximately 30 minutes to complete, although this may vary depending on your answers. Once you have finished your survey, please place it in the reply-paid envelope provided and send it back to us. Please note that you do not need a stamp to return the survey.

When marking your answers on the survey, please clearly tick or circle your response so we can easily see which answer you chose. For example:

When asked to tick your answer, please do so like this:

☐ Yes  ☒ No

When asked to circle your answer, please do so like this:

<table>
<thead>
<tr>
<th>Strongly disagree</th>
<th>Disagree</th>
<th>Neither agree nor disagree</th>
<th>Agree</th>
<th>Strongly Agree</th>
<th>Don’t know</th>
<th>Not applicable</th>
</tr>
</thead>
</table>

If you make an error, please clearly cross out the incorrect answer and choose the correct answer. For example:

<table>
<thead>
<tr>
<th>Strongly disagree</th>
<th>Disagree</th>
<th>Neither agree nor disagree</th>
<th>Agree</th>
<th>Strongly Agree</th>
<th>Don’t know</th>
<th>Not applicable</th>
</tr>
</thead>
</table>
Section A  Your physical activity

The following questions will ask you about the time you spent being physically active in the last 7 days, solely for recreation, sport, exercise or leisure. Think about only those physical activities that you did for at least 10 minutes at a time.

Please note: Vigorous physical activities refer to activities that take hard physical effort and make you breathe much harder than normal. Moderate activities refer to activities that take moderate physical effort and make you breathe somewhat harder than normal.

A1.  a. During the last 7 days, on how many days did you walk for at least 10 minutes at a time in your leisure time?

   _____ days per week

   [ ] No walking in leisure time  ➔  Skip to question A2

b. How much time did you usually spend on one of those days walking in your leisure time?

   _____ hours per day   _____ minutes per day

A2.  a. During the last 7 days, on how many days did you do vigorous physical activities like aerobics, running, fast bicycling, or fast swimming in your leisure time?

   _____ days per week

   [ ] No vigorous activity in leisure time  ➔  Skip to question A3

b. How much time did you usually spend on one of those days doing vigorous physical activities in your leisure time?

   _____ hours per day   _____ minutes per day

A3.  a. During the last 7 days, on how many days did you do moderate physical activities like bicycling at a regular pace, swimming at a regular pace, and doubles tennis in your leisure time?

   _____ days per week

   [ ] No moderate activity in leisure time  ➔  Skip to question A4

b. How much time did you usually spend on one of those days doing moderate physical activities in your leisure time?

   _____ hours per day   _____ minutes per day
TIME SPENT SITTING

These questions are about the time you spend sitting at work, at home, while doing study, and during your leisure-time. This may include time spent sitting at a desk, visiting friends, sitting or lying down to watch television or sitting in a motor vehicle.

A4.  
a. During the last 7 days, how much time did you usually spend sitting at work on a weekday (if you did not work on a week day your answer would be 0 hours per day)?

     _____ hours per day    _____ minutes per day

b. During the last 7 days, how much time did you usually spend sitting at work on a weekend day? (if you did not work on the weekend your answer would be 0 hours per day)

     _____ hours per day    _____ minutes per day

A5.  
a. During the last 7 days, how much time in total did you usually spend sitting during your leisure-time on a weekday (e.g. watching TV, surfing the internet, reading, sitting listening to music)

     _____ hours per day    _____ minutes per day

b. During the last 7 days, how much time in total did you usually spend sitting during your leisure-time on a weekend day (e.g. watching TV, surfing the internet, reading, sitting listening to music)

     _____ hours per day    _____ minutes per day

A6.  
a. During the last 7 days, how much time did you usually spend sitting watching TV on a weekday?

     _____ hours per day    _____ minutes per day

b. During the last 7 days, how much time did you usually spend sitting watching TV on a weekend day

     _____ hours per day    _____ minutes per day

A7.  
a. During the last 7 days, how much time did you usually spend sitting at the computer on a weekday?

     _____ hours per day    _____ minutes per day

b. During the last 7 days, how much time did you usually spend sitting at the computer on a weekend day?

     _____ hours per day    _____ minutes per day
Since physical activity is important for mental health, we’re interested in finding out a little bit more about your well-being.

B1. Below is a list of some of the ways you may have felt or behaved. Please indicate how often you have felt this way during the **past week**: (Please circle one answer on each line)

<table>
<thead>
<tr>
<th></th>
<th>a. I was bothered by things that usually don’t bother me</th>
<th>b. I had trouble keeping my mind on what I was doing</th>
<th>c. I felt depressed</th>
<th>d. I felt that everything I did was an effort</th>
<th>e. I felt hopeful about the future</th>
<th>f. I felt fearful</th>
<th>g. My sleep was restless</th>
<th>h. I was happy</th>
<th>i. I felt lonely</th>
<th>j. I could not “get going”</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Rarely/none of the time (less than 1 day)  </td>
<td>Some/a little of the time (1-2 days)  </td>
<td>Occasionally/moderate amount of the time (3-4 days)  </td>
<td>All of the time (5-7 days)  </td>
<td>Rarely/none of the time (less than 1 day)  </td>
<td>Some/a little of the time (1-2 days)  </td>
<td>Occasionally/moderate amount of the time (3-4 days)  </td>
<td>All of the time (5-7 days)  </td>
<td>Rarely/none of the time (less than 1 day)  </td>
<td>Some/a little of the time (1-2 days)  </td>
</tr>
</tbody>
</table>
The following section relates to the information booklet ‘Ladies, get active in your neighbourhood’ (provided in the pack). The information booklet provides information about why it is important to be physically active and reduce sitting time, practical ideas to increase levels of physical activity and reduce sitting time, availability of facilities to exercise in the neighbourhood (including women’s only facilities, recreational clubs, exercise options for mums, as well as safer areas to exercise), availability of childcare facilities in the neighbourhood, and contact information for various support groups.

Please read through the information booklet first and then provide us with your feedback by completing this questionnaire.

There are eight questions in this section. Where you are asked to write a written answer please read the question carefully and answer the best you can in the space provided. Where you are asked to provide a ‘rating’ (question D3), please circle the most suitable option on the scale provided.

**C1.** What do you like about the information booklet?

__________________________________________________________________________________________
__________________________________________________________________________________________
__________________________________________________________________________________________
__________________________________________________________________________________________
__________________________________________________________________________________________
__________________________________________________________________________________________
__________________________________________________________________________________________
__________________________________________________________________________________________

**C2.** What don’t you like about the information booklet?

__________________________________________________________________________________________
__________________________________________________________________________________________
__________________________________________________________________________________________
__________________________________________________________________________________________
__________________________________________________________________________________________
__________________________________________________________________________________________
__________________________________________________________________________________________
__________________________________________________________________________________________
C3. Please indicate how useful you found the following sections of the information booklet
(Please circle one answer on each line)

<table>
<thead>
<tr>
<th>Section</th>
<th>Not at all useful to me</th>
<th>Somewhat useful to me</th>
<th>Useful to me</th>
<th>Very useful to me</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. Information on the health benefits of physical activity (page 2)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>b. Tips on how to fit physical activity into daily life (page 3)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>c. Tips on how to reduce daily sitting time (page 4)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>d. Information on places to be physically active in your neighbourhood (page 5)</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>e. Information on safer areas to walk in your neighbourhood (page 7)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>f. Information on places to walk your dog in your neighbourhood (page 8)</td>
<td></td>
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<tr>
<td>g. Information on recreational clubs in your neighbourhood (page 9)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>h. Information on women’s only exercise options in your neighbourhood (page 11)</td>
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<td></td>
</tr>
<tr>
<td>i. Information on exercise options for mums (page 12)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>j. Information on childcare facilities in your neighbourhood (page 13)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>k. Information on support groups for those suffering depressive symptoms (page 14)</td>
<td></td>
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<td></td>
<td></td>
</tr>
</tbody>
</table>

Not applicable/I don’t have children
C4. What other information do you think would be useful in motivating you to...

a) Be more active?
__________________________________________________________________________________________
__________________________________________________________________________________________
__________________________________________________________________________________________
__________________________________________________________________________________________
__________________________________________________________________________________________

b) Sit less?
__________________________________________________________________________________________
__________________________________________________________________________________________
__________________________________________________________________________________________
__________________________________________________________________________________________
__________________________________________________________________________________________

C5. In what way would the information be best delivered? (e.g. monthly instalments in the mail [leaflets] or emails, all at once, a website, an i-phone application etc.)
__________________________________________________________________________________________
__________________________________________________________________________________________
__________________________________________________________________________________________
__________________________________________________________________________________________
__________________________________________________________________________________________

C6. In what ways would the information booklet help you...

a) Be more active?
__________________________________________________________________________________________
__________________________________________________________________________________________
__________________________________________________________________________________________
__________________________________________________________________________________________

b) Sit less?
__________________________________________________________________________________________
__________________________________________________________________________________________
__________________________________________________________________________________________
__________________________________________________________________________________________
C7. Have you used/been exposed to an information booklet promoting physical activity in your area previously?

- a. Yes
- b. No
- c. Not sure

C8. Is there anything else you want to tell us about your thoughts on the information booklet?

___________________________________________________________________________
___________________________________________________________________________
___________________________________________________________________________
___________________________________________________________________________
___________________________________________________________________________

Section D

Online calendar and diary

The following section relates to the online activity calendar and diary. An example of what the online activity calendar and diary screen may look like is provided in the pack along with step by step instructions. Please use this example as a guide when answering each question. The online activity calendar and diary is a website which allows users to log on and schedule their physical activity goals for the week, month and even year! The user can mark off daily when they have been physically active. At the end of the week, the computer program determines whether the user achieved their physical activity goals and provides feedback for the individual based on what they achieved. There is also an online forum which allows users to chat with other women and share any tips and advice they have for becoming physically active and reducing sitting time. A motivational quote is provided each day to help women achieve their physical activity goals.

Please read over the example of the online activity calendar and diary first and then provide us with your feedback by completing this questionnaire.

There are 10 questions in this section. Where you are asked to write a written answer please read the question carefully and answer the best you can in the space provided. Where you are asked to provide a ‘rating’ (question 3), please circle the most suitable option on the scale provided.

D1. What do you like about the online calendar and diary?
D2. What don’t you like about the online calendar and diary?

________________________________________________________________________________________

________________________________________________________________________________________

________________________________________________________________________________________

________________________________________________________________________________________

________________________________________________________________________________________

________________________________________________________________________________________

________________________________________________________________________________________

________________________________________________________________________________________

D3. Please indicate how useful you found the following aspects of the online calendar and diary (Please circle one answer on each line)

<table>
<thead>
<tr>
<th></th>
<th>The daily scheduling of physical activities</th>
<th>The personalised feedback from the computer regarding achieving your goals</th>
<th>The daily motivational quotes</th>
<th>The online forum to share tips and advice for being physically active</th>
</tr>
</thead>
<tbody>
<tr>
<td>a.</td>
<td>Not at all useful to me₁</td>
<td>Somewhat useful to me₂</td>
<td>Useful to me₃</td>
<td>Very useful to me₄</td>
</tr>
<tr>
<td>b.</td>
<td>Not at all useful to me₁</td>
<td>Somewhat useful to me₂</td>
<td>Useful to me₃</td>
<td>Very useful to me₄</td>
</tr>
<tr>
<td>c.</td>
<td>Not at all useful to me₁</td>
<td>Somewhat useful to me₂</td>
<td>Useful to me₃</td>
<td>Very useful to me₄</td>
</tr>
<tr>
<td>d.</td>
<td>Not at all useful to me₁</td>
<td>Somewhat useful to me₂</td>
<td>Useful to me₃</td>
<td>Very useful to me₄</td>
</tr>
</tbody>
</table>

D4. How would the online calendar and diary help you to set physical activity goals?

________________________________________________________________________________________

________________________________________________________________________________________

________________________________________________________________________________________

________________________________________________________________________________________

________________________________________________________________________________________

________________________________________________________________________________________

________________________________________________________________________________________

________________________________________________________________________________________

________________________________________________________________________________________

________________________________________________________________________________________
D5. In what ways would the online calendar and diary help you...
   
a) Be more active?
   ____________________________________________
   ____________________________________________
   ____________________________________________
   ____________________________________________
   ____________________________________________
   ____________________________________________

b) Sit less?
   ____________________________________________
   ____________________________________________
   ____________________________________________
   ____________________________________________
   ____________________________________________

D6. Have you used/been exposed to an online physical activity calendar and diary previously?
   
   a. Yes
   b. No
   c. Not sure

D7. Do you have any suggestions to make the online calendar and diary better?
   ____________________________________________
   ____________________________________________
   ____________________________________________
   ____________________________________________
   ____________________________________________
   ____________________________________________

D8. Which physical activity strategy did you like better and why? (i.e. The Information booklet or the online diary and calendar?)
   ____________________________________________
   ____________________________________________
   ____________________________________________
   ____________________________________________
   ____________________________________________
D9. Which physical activity strategy do you think would be more likely to result in an increase in physical activity and a reduction in daily sitting time and why? (i.e. The Information booklet or the online diary and calendar?)

a) More likely to increase physical activity?

__________________________________________________________________________________________
__________________________________________________________________________________________
__________________________________________________________________________________________
__________________________________________________________________________________________

b) More likely to reduce sitting time?

__________________________________________________________________________________________
__________________________________________________________________________________________
__________________________________________________________________________________________
__________________________________________________________________________________________
__________________________________________________________________________________________
__________________________________________________________________________________________

D10. Finally, do you have any other suggestions of strategies to increase physical activity and reduce sitting time amongst women?
**Section E  General Information**

Remember this information is strictly confidential and no data will be linked to your name or address.

**E 1**  
Age (yrs) _________

**E 2**  What is your marital status? (Please tick one response only)

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>a.</td>
<td>Married</td>
</tr>
<tr>
<td>b.</td>
<td>Defacto</td>
</tr>
<tr>
<td>c.</td>
<td>Separated / Divorced</td>
</tr>
<tr>
<td>d.</td>
<td>Widowed</td>
</tr>
<tr>
<td>e.</td>
<td>Never married</td>
</tr>
</tbody>
</table>

**E 3**  Do you have any children living with you now? (Please tick one response only)

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>a.</td>
<td>Yes</td>
</tr>
<tr>
<td>b.</td>
<td>No</td>
</tr>
</tbody>
</table>

If NO → skip to question A6

**E 4**  How many children do you have living at home?  
(Please record number) _________

**E 5**  How old are your children (who live at home)?

<table>
<thead>
<tr>
<th></th>
<th>Please specify in years</th>
<th>Not applicable</th>
</tr>
</thead>
<tbody>
<tr>
<td>How old is your eldest child?</td>
<td>___________ years old</td>
<td></td>
</tr>
<tr>
<td>How old is your 2nd eldest child?</td>
<td>___________ years old</td>
<td></td>
</tr>
<tr>
<td>How old is your 3rd eldest child?</td>
<td>___________ years old</td>
<td></td>
</tr>
<tr>
<td>How old is your 4th eldest child?</td>
<td>___________ years old</td>
<td></td>
</tr>
<tr>
<td>How old is your 5th eldest child?</td>
<td>___________ years old</td>
<td></td>
</tr>
<tr>
<td>How old is your 6th eldest child?</td>
<td>___________ years old</td>
<td></td>
</tr>
</tbody>
</table>
**E6** Are you currently pregnant? (Please tick one response only)

- [ ] d. Yes
- [ ] e. No
- [ ] f. Not sure

**E7** What is your highest level of education completed? (Please tick one response only)

- [ ] a. Never attended school
- [ ] b. Year 10 or equivalent
- [ ] c. Year 12 or equivalent
- [ ] d. Technical or trade school certificate/apprenticeship
- [ ] e. University or tertiary qualification

**E8** Which ONE of the following best describes your current main daily activities and/or responsibilities? (Please tick one response only)

- [ ] a. Working full-time
- [ ] b. Working part-time /casual
- [ ] c. Unemployed/ or laid off
- [ ] d. Keeping house and/or raising children full-time
- [ ] e. Student
- [ ] f. Retired

**E9** In which country were you born? (Please tick one response only)

- [ ] a. Australia
- [ ] b. UK
- [ ] c. Italy
- [ ] d. Greece
- [ ] e. New Zealand
- [ ] f. Vietnam
- [ ] g. Other
Thank you very much for taking the time to complete this questionnaire. Your responses will provide valuable information that will help to improve health and increase physical activity amongst women. If you have any other comments, please include them below.
Appendix 15

Telephone script to community/neighbourhood centres for Study 4
Script for telephone call to community house – for poster display

Good morning/afternoon,

My name is Megan Teychenne and I am a PhD candidate at Deakin University, Melbourne.

I am conducting a research project that looks at different strategies that may be useful in promoting physical activity to women living in Neighbourhood X (Victoria) and I am currently in the process of recruiting women to complete the short survey.

Would you be interested in displaying a project recruitment flyer on the noticeboard at the community house?

[If no] That’s fine. Thank-you for your time today.

[If yes] Thank-you – I will mail you out the posters What is your preferred postal address?

________________________________________________________________________
________________________________________________________________________

I will post that to you today. Thank-you again for your time. If you have any questions regarding the study, please feel free to call me on: 9251 7262
Appendix 16

Recruitment posters for Study 4
Ladies, how easy is it to be active in Neighbourhood X?

RESEARCH PARTICIPANTS REQUIRED

✅ Are you a woman aged over 18?
✅ Do you live in Neighbourhood X?

If so, we would like to hear from you!

We are conducting a study looking at different strategies to promote physical activity amongst women living in Neighbourhood X. Whether you are active or not, your feedback is important to us!

You will be asked to fill out a short survey, which takes approximately 10-15 minutes. This will be mailed out to you so you can complete it when it suits you.

Your opinions and experiences will help us in our efforts to improve women’s health. In appreciation of your time, all respondents will go in the draw to have the chance to win a $200 Coles Myer gift card.

To see how you can become involved, or for more information regarding the study, please take a tab below and contact the project manager.
The Women’s Activity Study

RESEARCH PARTICIPANTS REQUIRED

✓ Are you a woman aged over 18?
✓ Do you live in Neighbourhood X?

If so, we would like to hear from you!

We are conducting a study looking at different strategies to promote physical activity amongst women living in Neighbourhood X. Whether you are active or not, your feedback is important to us!

You will be asked to fill out a short survey, which takes approximately 10-15 minutes. This will be mailed out to you so you can complete it when it suits you.

Your opinions and experiences will help us in our efforts to improve women’s health. In appreciation of your time, all respondents will go in the draw to have the chance to win a $200 Coles Myer gift card.

To see how you can become involved, or for more information regarding the study, please take a tab below and contact the project manager.
Appendix 17

Letter to community/neighbourhood centre for Study 4
Dear [Name],

Further to my phone conversation with reception this morning, I am forwarding a project recruitment flyer for our study to be displayed on a notice board in your centre.

As discussed earlier, we are conducting a study that explores how women living in Neighbourhood X feel about programs and strategies that aim to encourage physically active lifestyles. Our recruitment strategy involves a mail-out in your neighbourhood and it is greatly appreciated that you have agreed to compliment this by displaying our flyer in your centre. The flyer includes a brief description of the study with our contact details. The recruitment period is not set – it will depend on how quickly we reach the required number of participants. We will notify you when we no longer require the flyer to be displayed.

Thank you again for your support of our project. This important study aiming to improve women’s health could not be conducted without the support of the local community. If you have any further queries please contact me on 9251 7262.

Yours Sincerely,

Megan Teychenne
Project Manager
Appendix 18

Letter of invitation for women to participate in Study 4
The Women’s Activity Study

Dear Madam,

My name is Megan Teychenne and I am a PhD student in the School of Exercise and Nutrition Sciences at Deakin University. I am conducting a research project that looks at different strategies that may be useful in promoting physical activity to women living in Neighbourhood X (Victoria). This will be done by asking women living in Neighbourhood X and who are aged 18 years and over to provide us with feedback on two strategies we have designed (an information booklet and website) to increase physical activity amongst women.

If you would like to take part in this research I will ask that you read the enclosed plain language statement before completing the questionnaire. A reply-paid envelope has been provided for you to return the completed questionnaire. You will not be paid for your participation in this project. However, all respondents who return a completed survey will go in the draw to have the chance to win a $200 Coles Myer gift card in appreciation of your time.

Please be assured that we will protect your confidentiality of your involvement in this study to the fullest possible extent. Your individual information will not be identifiable in the report; it will be held in confidence and will be stored securely at Deakin University. All information will be used for research purposes only.

This is an important research study, but please know that your participation in this study is completely voluntary. If you have any questions regarding this study, please don’t hesitate to contact me by telephoning 03 9251 7262 between 9am and 5pm weekdays or emailing mteych@deakin.edu.au

Thank you,

Ms Megan Teychenne, PhD Student, School of Exercise & Nutrition Sciences, Deakin University, Burwood
Appendix 19

Information booklet intervention for Study 4
Ladies, get active in your neighbourhood!

An information booklet for women living in Neighbourhood X, Victoria

March 2010
Physical activity: What are the benefits?

Physical activity has numerous **physical** and **mental** health benefits for women of all ages. Benefits include:

- Reduced risk of heart disease
- Reduced risk of type 2 diabetes
- Reduced risk of some cancers (including breast cancer)
- Decreased body fat
- Stronger immune system
- Increased energy
- Reduced risk of depression and anxiety
- Improved mood and sense of well being

To achieve these health benefits, it is recommended that Australian adults participate in at least **30 minutes** of **moderate-intensity** physical activity on **5** or more days of the week. This can be accumulated in 10 minute bouts.
Many women struggle to find time to fit physical activity into their busy lives. However, even the busiest of women can find time for physical activity. Try some of the following tips:

- **Wake up early.** Get up 30 minutes earlier than you usually do and go for a brisk walk, bike ride or (if it’s raining) try doing yoga or strength exercises in your lounge room.

- **Be active as a family.** We know that childcare can be difficult to find, so why not involve the kids in your physical activity routine? Go for a walk after dinner, play games and sports in the backyard or go for a swim yourself when your kids have swimming lessons.

- **Be active with a friend.** Rather than catching up with a friend over coffee, go for a walk in the local park or join the local gym together. This will also increase your motivation to stick to it.

- **Be active for transport.** Walk to work or cycle to the shops. If you must drive, park the car a few blocks away and walk from there.

- **Schedule physical activity like you would any other appointment.** Make physical activity a part of your everyday routine by scheduling it into your diary or planner. Whether it is a morning, evening or lunchtime event, you can find a way to be physically active.
Reducing daily sitting time: How can I do this?

Since sitting watching TV or at the computer can have negative health effects, it is important to find ways to reduce the time you spend sitting each day. Try some of the following tips:

- **Be active while watching TV.** If you can’t get yourself away from the TV, try using hand weights, ride an exercise bike or do some stretching while watching your favourite program. You could also hide the remote so that you must get up to change the channel or volume, or use the ad breaks as an opportunity to stand up.

- **Multi-task.** Get those household chores done at the same time as watching TV. Stand up and do the ironing, fold the washing or cook. This will give you more time to exercise too!

- **Stand up!** If you spend long periods sitting at the computer at work or home, try standing while working at the computer. Just prop your computer and keyboard up on a box and you are ready to work! This will keep your mind refreshed and may reduce back pain.
Places to be physically active in Neighbourhood X

There are plenty of facilities available in Neighbourhood X for you to exercise. Details are provided below and shown on the reference map (page 15):

**Pelican Park Walking Track**
Sommerville - Balnarring (26km):
Activities: Walking, running, cycling, horse riding * amongst bushland, wetlands, native animals and views of Western Port
(*only small section – lane- see Point 23 on reference map)
Cost: Free
Opening hours: All day, every day!
Contact:
Website:

**Rec Park (Distance markers along the way)**
Activities: Gym equipment, personal training, Swimming pool, Childcare, Group fitness classes, All access fitness classes (suitable for older adults, people with low fitness, or people with disabilities)
Cost: Aquatics: $4.40/$3.10 conc, Swim/Gym/Group /All access fitness Classes: $12/$8.50 conc. Memberships available
Opening hours: 6am-9pm (Mon-Fri), 8am-7pm (weekends)
Contact:
Website: www.***.vic.gov.au

**Gym (Women’s only)**
2/105 St, (see map)
Activities: Gym equipment, fitness trainers (29-minute work-out)
Cost: a) $79p/month ($145 joining fee) or b) $59 p/month ($95 joining fee) min 12 months
Opening hours: 6.30am-8pm (Mon & Wed), 6.30am-7pm (Tues, Thurs, Fri), 8am-12pm (Sat)
Contact:
Website: www.contours.net.au

**Neighbourhood X**

**Recreation Centre**
Parade, (see map)
Activities: Gym equipment, personal training, Swimming pool, Childcare, Group fitness classes, All access fitness classes (suitable for older adults, people with low fitness, or people with disabilities)
Cost: Aquatics: $4.40/$3.10 conc, Swim/Gym/Group /All access fitness Classes: $12/$8.50 conc. Memberships available
Opening hours: 6am-9pm (Mon-Fri), 8am-7pm (weekends)
Contact:
Website: www.***.vic.gov.au

**Section of the Pelican Park walking track**
**Tennis Club**

54 Parade, [address]

*Activities:* Tennis court hire

*Cost:* $10 per hour (+$20 refundable deposit)

*Opening hours:* Times other than when tournaments/training/matches are on (see page 10)

*Contact:* The Sandwich Café, [address]

**Community Hub**

1973 [address]

*Activities:* Basketball, Netball, Squash
courts to hire

*Cost:* Squash court: $8 per hour/$22.50 per hour for entire stadium. Basketball and netball courts: $3.70pp/per hour/$22.50 per hour for entire stadium hire.

*Opening hours:* 9am-5pm (business hours) Court hire depends on availability (call to book and prepay at Community House, [address])

*Contact:* [address]

**Netball & Basketball courts**

54 Parade, [address] (next to tennis courts)

*Activities:* Netball and Basketball

*Cost:* Free

*Opening hours:* All day. Every day! Why not head down with your family or friends and shoot some hoops together!
Safer areas to walk in Neighbourhood X

Below is a list of the ‘safest’ places and/or routes for walking in which have safe and well-maintained paths, street lighting and/or are popular with walkers and runners.

**Walking Track**
Enter: Parade (near St),

Activities: Walking, running, cycling with views of Western Port – 3 tracks clearly marked: 1.1km/1.5km/2.3km
Opening hours: All day, everyday (dogs on lead 8am-8pm)
Contact: 1300 850 600
Website: www.vic.gov.au

This place has well-maintained paths and large parts of the track are shaded by trees. Popular with joggers, walkers (including dog walkers) and cyclists. As the paths have no lighting, it is best to exercise here during daylight hours.

**Bay Trail**
Sommerville - Balnarring (26km):
Enter: Reserve- Western Port Marina - Park (Distance markers along the way)

Activities: Walking, running, cycling, horse riding * amongst bushland, wetlands, native animals and views of Western Port
(*only small section – Entrance at Kinfauns lane)
Opening hours: All day, every day!
Contact:
Website: www.mornpen.vic.gov.au

The trail has well-maintained paths/boardwalk and is popular with walkers and cyclists. Some parts of the track are lit by street lighting (e.g. )

**Foreshore Reserve**
Enter:

Activities: Walking, running, cycling with views of Western Port – Popular off lead dog park
Opening hours: All day, everyday (dogs on lead 8am-8pm)
Contact: 1300 850 600
Website: www.mornpen.vic.gov.au

This place has well-maintained paths and is popular with walkers – especially dog walkers. A great place to meet other dog lovers! As the paths have no lighting, it is best to exercise here during daylight hours.
Places to walk your dog in Neighbourhood X

Below is a list of ‘dog friendly’ parks. Your pooch can roam around off lead and with other dogs, whilst you mingle with other dog owners or even run around yourself!

**Foreshore Reserve**
- Access via
- **Description:** A great place for walking, running, and cycling with views of Western Port – Very popular off lead dog park

**Kings Creek Reserve**
- Access via
- **Description:** Although this park doesn’t have well-maintained paths, it is a quiet place to walk your dog, alongside bushland.

**West Park Reserve**
- Access via
- **Description:** Although no walking paths, this small park is a nice quiet place to play ball with your dog.

**Reserve, Intersection of**
- **Description:** The walking path in this small park is well-maintained, with good street lighting along surrounding streets.

For further information regarding “leash free” areas to walk your dog, please contact the Mornington Peninsula Shire

1300 850 600
www.mornpen.vic.gov.au

Always look for this sign!
Recreational clubs/social physical activities in Neighbourhood X

Want to exercise with others? Joining a sports or recreation club can increase your motivation as well as enjoyment!

Heart Foundation Walking Group
Meets at [address]
Times: Tuesdays 10am (all abilities)
Cost: Free
Contact: [name]

Bicycle Users Group (BUG)
Meet at [address]
Times: Mondays 10am
Cost: Free (but you need to be a BUG member)
Contact: Rosemarie [name]

Tai Chi
Meet at [address]
Times: 2-3pm (intermediate), Tues 3-4pm (beginners)
Cost: $4 per class
Contact: [name]
Classes run by volunteers trained by Arthritis Victoria

Tai Chi
Meet at [address]
Times: Thursdays 9.30-10.30am
Cost: $75/$68 conc (8 weeks)
Contact: [name]
Website: www.
### Physical Fitness Program
**Class:** Physical Fitness Program (Catering for those over 50)
- **Location:** Hastings Community Hall (next to the Library), 3 St, Hastings
- **Times:** Thursdays 9.30am
- **Cost:** $5.40 per session
- **Contact:**
- **Notes:** Strength training, aerobics and functional exercises, catering for those over 50.

### Group Exercise Classes at Recreation Centre
**Class:** Group Exercise Classes at Recreation Centre
- **Times:** Various – Pick up fitness timetable from Pelican Park Recreation Centre
- **Cost:** Aquatics: $4.40/$3.10 conc, Group Exercise Classes: $12/$8.50 conc. All Access classes $12/$8.50 conc /$5.40 eligible patrons. Memberships available
- **Contact:**
- **Website:**
- **Classes include:**
  - Group Exercise
    - Aqua (pool)
    - Body Balance
    - Body Pump
    - Step & Tone
    - Tummy, Hips & Thighs
    - Aerobics
    - Fitball
    - Power Box
    - RPM (indoor cycling class)
- **All access**
  - Tai Chi
  - Circuit Breakers
  - Aquaeaze
  - Stay On Your Feet (SOYF)
  - Stay On Your Feet (SOYF) – Chair based

### Tennis Club
**Class:** Tennis Club
- **Location:** 54 Parade, Hastings
- **Times:** Oct-March - Wednesdays 6pm barefoot bowls-for beginners. Winter - Indoor bowls 7pm. Be there 15 minutes early
- **Cost:** $4 bowls (BBQ dinner also provided for a small charge)
- **Contact:**
- **Website:**

### Bowling Club
**Class:** Bowling Club
- **Location:** Hastings Bowling Club, Parade, Hastings
- **Times:** Oct-March - Wednesdays 6pm barefoot bowls-for beginners. Winter - Indoor bowls 7pm. Be there 15 minutes early
- **Cost:** $4 bowls (BBQ dinner also provided for a small charge)
- **Contact:**
- **Website:**

### (Football) Netball Club
**Class:** (Football) Netball Club
- **Location:** Hastings (Football) Netball Club, Oval, Hastings
- **Description:** Home matches played at Primary School. For times and cost please contact Karen.
- **Contact:**
- **Website:**

### Belly Dancing
**Class:** Belly Dancing
- **Location:** Hastings Community House.
- **Times:** Wednesday 6.30-7.30pm (Beginners), 7.30-8.30pm (Advanced)
- **Cost:** $50 (7 weeks)
- **Contact:**
- **Website:**
Physical activity just for women

If you prefer to just be in the company of women when you exercise, here’s where to go!

**Gym (Women’s only)**
2/105 [see map](#)
*Activities:* Gym equipment, fitness trainers (29-minute work-out)
*Cost:* a) $79p/month ($145 joining fee) or 
b) $59 p/month ($95 joining fee) min 12 months
*Opening hours:* 6.30am-8pm (Mon & Wed), 6.30am-7pm (Tues, Thurs, Fri), 8am-12pm (Sat)
*Contact:*
*Website:*

**Hastings Tennis Club – Mid week**
*Ladies*
54 [see map](#)
*Times:* Wednesday (Mid week ladies) 9am, Saturday afternoon (seniors) 1pm. Additional tournaments played ask Ray.
*Cost:* $95 yearly membership/$160 family. + $2.50 on day
*Contact:*

**Hastings (Football) Netball Club**
23 Oval, [see map](#)
*Home matches played at Primary School*
*For times and cost please contact Karen.*
*Contact:*
*Website:*

**Contours Gym (Women’s only)**
*Activities:*
*Cost:*
*Opening hours:*
*Contact:*
Physical activity for mums

If you can’t find a friend or family member to look after the kids, you can still be active in your nearby community. Here’s how:

**Expecting Results**
Various locations around
**Times:** Thurs-Sat at various time – see website for timetable
**Cost:** $12 per session. $100 for 10 sessions. $180 for 20 sessions
**Contact:**
**Website:**
*Group prenatal and postnatal exercise training. 'Buggy workout' and 'mums on the run' are just some of the programs offered.*

**New Mum’s Stroller Group**
Meet at
**Times:** Fridays 9am (March)
**Cost:** Free
**Contact:**
**Website:**
*Aerobic and strength training session*

If you aren’t able to travel for these classes, then why not organise your own stroller group with local mums!
Childcare facilities

There are several childcare facilities around [location] which allow you to drop the kids off and pick them up when you have completed your work-out! These are marked with a ★

★ Child Care
Recreation Centre, [location]
Times: Mon, Wed, Fri 9am-12 noon: Tues, Thurs 9am-12.30 noon
Cost: Starting at $3.80p/hour or $6.50p/hour (occasional care - e.g. for parents not using the facilities)
Contact: [contact info]
Website: [website]

★ Child Care Centre
27 [address]
Times: 6.30am-5.30pm (Mon-Fri)
Cost: $57 daily, $235 weekly. Meals and nappies included. Subject to CC rebate*
Contact: [contact info]
Website: [website]

★ Child and Family Centre
6 [address]
Times: Occasional care Weds 9.15am-12.15pm
Cost: $10.50 (1 child), $18 (2 child), $20 (3 child)
Contact: [contact info]

★ Early Learning Centre
Times: 6.30am-6.30pm (Mon-Fri)
Cost: $58 daily, $240 weekly. Includes nappies, food, and education programs. Subject to CC rebate*
Contact: [contact info]
Website: [website]

★ Shire - Home based family day care
Home-based in carers homes
Times: Full-time, part-time, casual, before or after school care.
Cost: Fees are subject to the individual carer
Contact: [contact info]
Website: [website]

★ Child Care Centre
Times: 6am-6pm (Mon-Fri)
Cost: $57 daily. *Subject to CC rebate (*can be as little as $3.30 per day through rebate)
Contact: [contact info]

*For more information on the Government Child Care Rebate, visit the website: www.familyassist.gov.au
Support groups

Physical activity can help alleviate depressive symptoms. If you are feeling down or depressed, stressed or anxious, there are several support groups which are here to help you.

National Services
beyondblue
Web and telephone-based depression info hotline (24 hours)
Contact: 1300 224 636
Website: www.beyondblue.org.au

GROW
Groups and resources for those not coping
Contact: 1800 558 268 or email national@grow.net.au
Website: www.grow.net.au

Local Services
Support Services
For those experiencing mental health difficulties. Groups are offered in
Address: 
Contact: 
Website: 

Health Community Health Service
Local counselling service
Address: 
Contact: 
Website: 

Youth & Family Service
Local counselling service
Contact: or e-mail
Website: 

Local Services
Support Services
For those experiencing mental health difficulties. Groups are offered in
Address: 
Contact: 
Website: 

Health Community Health Service
Local counselling service
Address: 
Contact: 
Website: 

Youth & Family Service
Local counselling service
Contact: or e-mail
Website: 
Places of interest for Ladies getting active around Hastings!

1. Western Port Bay Trail – Jack Babington Park
2. Western Port Bay Trail – Warringine Park
3. Contours Gym
4. Pelican Park Recreation Centre
5. Pelican Park Walking Track
6. Hastings Tennis Club
7. Hastings Community Hub
8. Hastings Foreshore Reserve (leash free area)
9. Villawood Reserve (leash free area)
10. Cypress-Samuel Reserve (leash free area)
11. Tara Reserve (leash free area)
12. West Park Reserve (leash free area)
13. Kings Creek Reserve (leash free area)
14. Wallaroo Community Centre/Child and Family Centre
15. Hastings Community House/Peninsula Health Community Health Services
16. Hastings Hall (Fitness Program)
17. Hastings Bowling Club
18. Hastings (Football) Netball Club
19. Hastings Child Care Centre
20. Western Port Child Care Centre
21. Fun 4 Kids Early Learning Centre
22. Good Shepherd Youth & Family Service
23. Horse riding trail (Warringine Park)
Appendix 20

Online diary and calendar intervention for Study 4
Welcome Jane, to your personal ONLINE ACTIVITY CALENDAR AND DIARY


<table>
<thead>
<tr>
<th>Physical activity goal for the week:</th>
<th>Monday</th>
<th>Tuesday</th>
<th>Wednesday</th>
<th>Thursday</th>
<th>Friday</th>
<th>Saturday</th>
<th>Sunday</th>
<th>Weekly goal achieved?</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>4 sessions</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 Walk to Villawood Reserve</td>
<td>2</td>
<td>3</td>
<td></td>
<td>4</td>
<td>5</td>
<td>X</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>8</td>
<td>9</td>
<td>10</td>
<td>11</td>
<td>12</td>
<td>13</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Walk to West Park Reserve</td>
<td>Facebook (stand-up!)</td>
<td>11 Facebook (stand-up!)</td>
<td>12 Facebook (stand-up!)</td>
<td>13 8km bike ride to Hastings Foreshore</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>4 sessions</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>14 Facebook (stand-up!)</td>
<td>15</td>
<td>16</td>
<td>17</td>
<td>18</td>
<td>19</td>
<td>20</td>
<td></td>
<td></td>
</tr>
<tr>
<td>While kids are at swimming lessons: Swim 10 laps</td>
<td>While kids are at swimming lessons: Swim 10 laps</td>
<td>Facebook (stand-up!)</td>
<td>Facebook (stand-up!)</td>
<td>Walk the Pelican Park walking track with Susie</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>5 sessions</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>21</td>
<td>22</td>
<td>23</td>
<td>24</td>
<td>25</td>
<td>26</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>How many sessions this week?</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

1. Click here to find out!

2. Click on the month you want to visit

3. Click here to type the number of physical activity sessions you want to achieve this week!

4. Click on a date to schedule your physical activity sessions so that they fit into your weekly routine.

5. Did you achieve your weekly goal? Click here to find out!

6. Click on the online forum to share tips with other women for getting physically active and reducing your daily sitting time!

Today's thought:
The difference between try and triumph is just a little umph! – Marvin Phillips

Online Forum
Appendix 21

Instructions for online diary and calendar intervention for Study 4
ONLINE ACTIVITY CALENDAR AND DIARY

Instructions:

An example of what the online activity calendar and diary screen may look like is provided in the pack. The online activity calendar and diary is a website which allows users to log on and schedule their physical activity goals for the week, month and even year! The user can mark off daily when they have been physically active.

These instructions will help you understand each function of the website.

1. Log on and off by clicking on the button in the top right hand corner

2. Select a month of the year that you want to view by clicking on that month

3. Select the number of physical activity sessions you want to achieve in a particular week by clicking on the left hand column of the calendar

4. Select a specific day/date to schedule a physical activity session by clicking on the chosen date. Then type in your session/goal. Remember this can be a session to increase physical activity or reduce sitting time. Do this as many times as needed for the week. You can also mark off whether you achieved your session or not by clicking on the scheduled date.

5. Once you have marked off each achieved session for that week, click on the 'Goal achieved?' button in the right hand column of the calendar. At the end of the week, the computer program determines whether the user achieved their physical activity goal and provides feedback for the individual based on what they achieved.

6. The online forum allows users to chat with other women and share any tips and advice they have for becoming physically active and reducing sitting time. Click on the button at the bottom of the screen to see other women’s discussions and to post your own questions and tips.

7. A motivational quote is provided each day to help women achieve their physical activity goals. Click on the button in the top left hand corner of the screen to see a new quote.
Appendix 22

Plain language statement for Study 4
DEAKIN UNIVERSITY
PLAIN LANGUAGE STATEMENT AND CONSENT FORM

TO: Participant

**Plain Language Statement**

**Date:**

**Full Project Title:** The Women’s Activity Study

**Principal Researcher:** Associate Professor Kylie Ball

**Student Researcher:** Ms Megan Teychenne

**Associate Researcher(s):** Associate Professor Jo Salmon

---

This Plain Language Statement is 3 pages long. Please make sure you have all the pages.

2.1. **Your Consent**

You are invited to take part in this research project.

This Plain Language Statement contains detailed information about the research project. Its purpose is to explain to you as openly and clearly as possible all the procedures involved in this project so that you can make a fully informed decision whether you are going to participate.

Please read this Plain Language Statement carefully. Feel free to ask questions about any information in the document. You may also wish to discuss the project with a relative or friend or your local health worker. Feel free to do this.

Once you understand what the project is about and if you agree to take part in it, please fill out the enclosed survey. Return of the completed survey indicates that you understand the information and that you intend to consent to participate in the research project.

You will be given a copy of the Plain Language Statement to keep as a record.

2.2. **Purpose and Background**

The purpose of this project is to develop an understanding of factors that affect possible strategies to help women be active. Physical activity is essential for good physical and mental health. As women are at a greater risk of inactivity than men, they are an important target group for further research for promoting physical activity. Although programs are available to help adults increase their level of physical activity, there are very few that deal with issues specific to women. Research also shows that physical activity habits differ for women according to the area in which they live, with women living in certain areas tending to face similar barriers and motivators. This project seeks to better understand some of these issues, and to explore what women feel would work to help them be more active.

We anticipate total of 208 people will participate in this project.
We are particularly interested in women living in the area of [redacted] (Victoria). We would like to invite you to participate in this study if you are a woman aged 18 and over, and living in the suburb of [redacted]. Please note - If there is more than one woman aged over 18 years and living in your household, the woman with the next upcoming birthday may participate in this study). Your involvement would be appreciated as we hope to learn more about what strategies may be useful in promoting women’s physical activity in suburbs such as [redacted]. This research will contribute towards Megan Teychenne achieving her PhD qualification.

2.3. Procedures
Participation in this project will involve completing the enclosed questionnaire which asks you to provide feedback on two strategies that have been designed to increase physical activity amongst women. The questionnaire will also ask questions about your physical activity levels, time spent sitting as well as your well-being, since research has found physical activity to be beneficial for emotional well-being. The questionnaire should take approximately 20-35 minutes to complete. We have included a reply-paid envelope for you to return the questionnaire to Deakin University. Please be assured that all information will remain confidential and will be used for research purposes only.

2.4. Possible Benefits
We cannot guarantee or promise that you will receive any benefits from this project.

2.5. Possible Risks
Due to the voluntary nature of the research and the content of the questionnaire there are no foreseen risks, side effects or discomforts associated with participating in this research. There are no consequences for choosing not to participate.

2.6. Privacy, Confidentiality and Disclosure of Information
Please be assured that we will protect your confidentiality of your involvement in this study at all times. All study data will be held in confidence and will be stored securely in locked cupboards at Deakin University for a period of six years after project completion. All identifying information will be removed from the data prior to storage and all information will be used for research purposes only. Once the research has been completed, the results will be presented at academic conferences and published in academic journals, but these will never identify any individual participant. Only members of the research team will have access to your personal contact details should you provide them.

2.7. Results of Project
At the end of the study we will send you a short summary of the overall findings if you indicate your interest in receiving these (a tick-box slip is provided in the pack).

2.8. Participation is Voluntary
Participation in any research project is voluntary. If you do not wish to take part you are not obliged to.

Your decision whether to take part or not to take part will not affect your relationship with Deakin University.

Before you make your decision, a member of the research team will be available to answer any questions you have about the research project. You can ask for any information you want. Return the questionnaire only after you have had a chance to ask your questions and have received satisfactory answers. Once you have returned your questionnaire, you will be unable to withdraw from the study as all information in anonymous.
2.9. Ethical Guidelines
This project will be carried out according to the National Statement on Ethical Conduct in Human Research (2007) produced by the National Health and Medical Research Council of Australia. This statement has been developed to protect the interests of people who agree to participate in human research studies.

The ethics aspects of this research project have been approved by the Human Research Ethics Committee of Deakin University.

2.10. Complaints
If you have any complaints about any aspect of the project, the way it is being conducted or any questions about your rights as a research participant, then you may contact:
The Secretary HEAG-H, Dean’s Office, Faculty of Health, Medicine, Nursing and Behavioural Sciences, 221 Burwood Highway, Burwood Victoria 3125, Telephone: 9251 7174, E-mail: hmnbs-research-ethics@deakin.edu.au.

Please quote project number HEAG-H32-2010.

2.11. Reimbursement for your costs
You will not be paid for your participation in this project. However, all respondents who return a completed survey have the opportunity to go in the draw to have the chance to win a $200 Coles Myer gift card in appreciation of your time.

2.12. Further Information, Queries or Any Problems
Some of the questions in the survey ask about your well-being and mood. If you are experiencing elevated symptoms or feel you require information, help or advice regarding your well-being and mood, please contact: www.beyondblue.org.au

If you require further information or if you have any problems concerning this project (for example, any side effects), you can contact the principal researcher or associate researchers.

The researchers responsible for this project are:

A/Prof Kylie Ball
Principal Researcher
School of Exercise & Nutrition Sciences
Deakin University
221 Burwood Hwy Burwood
(03) 9251 7310
kball@deakin.edu.au

Ms Megan Teychenne
Associate Researcher
School of Exercise & Nutrition Sciences
Deakin University
221 Burwood Hwy Burwood
(03) 9251 7262
mteych@deakin.edu.au

Prof Jo Salmon
Associate Researcher
School of Exercise & Nutrition Sciences
Deakin University
221 Burwood Hwy Burwood
(03) 9251 7254
jo.salmon@deakin.edu.au
Appendix 23

Contact information slip for Study 4
**The Women’s Activity Study**

If you would to be entered into the draw to win a **$200 Coles Myer voucher** please tick the appropriate box and provide your contact information below. This information will be kept confidential and **will not be used for any other purposes** other than to contact you if you are a winner.

- **Yes**, I would like to go into the **draw** to win a $200 Coles Myer **voucher**
- **No**, I would not like to go into the **draw** to win a $200 Coles Myer **voucher**

If you would to receive a **general letter describing the results of this study** please tick the appropriate box and provide your contact information below. This information will be kept confidential and **will not be used for any other purposes** other than to send you the letter of results after the end of the study.

- **Yes**, I would like to receive a **letter of results**
- **No**, I would not like to receive a **letter of results**

Name: _________________________________________________________________

Address: ______________________________________________________________________

____________________________________________________________________________

____________________________________________________________________________

Phone number: __________________________  Mobile: __________________________

E-mail: __________________________________________________________________________

*Please return this slip in the reply-paid envelope provided*
Appendix 24

Reminder letter for Study 4
The Women’s Activity Study

Dear Madam,

Re: Research Study

A few weeks ago I sent you a questionnaire seeking your opinions about strategies aimed to increase physical activity amongst women living in [insert location]. This survey will provide important information about how we can promote women’s health.

If you have already completed and returned the questionnaire, please accept my sincere thanks. If not, I would be grateful if you would do so as soon as you can. In order for the findings of the study to properly represent community views it is important that your answers are included in the study.

If you have not received the questionnaire, or it has been misplaced, please contact us on (03) 9251 7262 between 9am and 5pm on weekdays so that we can post another one to you. Thank you for your help.

Yours sincerely,

Ms Megan Teychenne
Project Manager
Appendix 25

Key Stakeholders letter of invitation to participate in Study 4
The Women’s Activity Study

Dear Sir/Madam,

My name is Megan Teychenne and I am a PhD student in the School of Exercise and Nutrition Sciences at Deakin University. I am conducting a research project that looks at different strategies that may be useful in promoting physical activity and reducing sedentary behaviour to women living in [ ] (Victoria). This study will involve key stakeholders in the community, from organisations such as yours, providing us with feedback on two strategies we have designed (an information booklet and website) to increase physical activity amongst women.

I will soon be inviting you, as a representative of your organisation, to participate in this study by completing a short self-administered survey.

As a member of an organisation concerned with the health and well-being of people in the community of [ ], I believe you can make a valuable contribution to assessing strategies to increase physical activity and reduce sedentary behaviour amongst women living in the community. I am looking forward to hearing about your views and opinions on this important issue.

Within the next two weeks, I will be calling you to invite you to participate in this study. Please know that your participation in this study is completely voluntary. If you have any questions regarding this study, if you would like to recommend another person from your organisation, or to opt out of this study, please contact me by telephoning (03) 9251 7262 between 9am and 5pm weekdays or email mteych@deakin.edu.au

Thank you,

Ms Megan Teychenne, PhD Student, School of Exercise & Nutrition Sciences, Deakin University, Burwood
Appendix 26

Telephone script inviting key stakeholders to participate in Study 4
Script for telephone call to key stakeholders:

Good morning/afternoon,

My name is Megan Teychenne and I am a PhD candidate at Deakin University, Melbourne.

I recently sent you a letter inviting you to participate in a study I am conducting which will obtain feedback from key stakeholders on the perceived feasibility and effectiveness of two strategies designed to promote physical activity and reduce sedentary behaviour amongst women living in [insert location].

Did you receive the letter? (If no, ask if they would like to receive the letter)

Would you be interested in participating?

[If no] That’s fine. Thank-you for your time today.

[If yes] Thank-you – Your participation in this study is greatly appreciated. I will mail you out the survey. What is your preferred postal address?

I will post that to you today. Thank-you again for your time. If you have any questions regarding the study, please feel free to call me on: 9251 7262
Appendix 27

Plain language statement for key stakeholders in Study 4
DEAKIN UNIVERSITY
PLAIN LANGUAGE STATEMENT AND CONSENT FORM

TO: Key Stakeholder

Plain Language Statement

Date:

Full Project Title: The Women's Activity Study

Principal Researcher: Associate Professor Kylie Ball

Student Researcher: Ms Megan Teychenne

Associate Researcher(s): Associate Professor Jo Salmon

This Plain Language Statement is 3 pages long. Please make sure you have all the pages.

2.13. Your Consent

You are invited to take part in this research project.

This Plain Language Statement contains detailed information about the research project. Its purpose is to explain to you as openly and clearly as possible all the procedures involved in this project so that you can make a fully informed decision whether you are going to participate.

Please read this Plain Language Statement carefully. Feel free to ask questions about any information in the document.

Once you understand what the project is about and if you agree to take part in it, please fill out the enclosed survey. Return of the completed survey indicates that you understand the information and that you intend to consent to participate in the research project.

You will be given a copy of the Plain Language Statement to keep as a record.

2.14. Purpose and Background

The purpose of this project is to develop an understanding of factors that affect possible strategies to help women be active. Physical activity is essential for good physical and mental health. As women are at a greater risk of inactivity than men, they are an important target group for further research for promoting physical activity. Although programs are available to help adults increase their level of physical activity, there are very few that deal with issues specific to women. Research also shows that physical activity habits differ for women according to the area in which they live, with women living in certain areas tending to face similar barriers and motivators. This project seeks to better understand some of these issues, and to explore what key stakeholder’s in the community feel would work to help women be more active.

We anticipate total of 208 people will participate in this project.
We are particularly interested in the views of key stakeholders in Hastings (Victoria). As a member of an organisation concerned with the health and well-being of people in the community of Hastings, we would like to invite you to participate in this study. Your involvement would be appreciated as we hope to learn more about what strategies may be useful in promoting women’s physical activity in suburbs such as Hastings. This research will contribute towards Megan Teychenne achieving her PhD qualification.

2.15. Procedures
Participation in this project will involve completing the enclosed questionnaire which asks you to provide feedback on two strategies that have been designed to increase physical activity amongst women. The questionnaire should take approximately 15 minutes to complete. We have included a reply-paid envelope for you to return the questionnaire to Deakin University. Please be assured that all information will remain confidential and will be used for research purposes only.

2.16. Possible Benefits
We cannot guarantee or promise that you will receive any benefits from this project.

2.17. Possible Risks
Due to the voluntary nature of the research and the content of the questionnaire there are no foreseen risks, side effects or discomforts associated with participating in this research. There are no consequences for choosing not to participate.

2.18. Privacy, Confidentiality and Disclosure of Information
Please be assured that we will protect your confidentiality of your involvement in this study at all times. All study data will be held in confidence and will be stored securely in locked cupboards at Deakin University for a period of six years after project completion. All identifying information will be removed from the data prior to storage and all information will be used for research purposes only. Once the research has been completed, the results will be presented at academic conferences and published in academic journals, but these will never identify any individual participant. Only members of the research team will have access to your personal contact details should you provide them.

2.19. Results of Project
At the end of the study we will send you a short summary of the overall findings if you indicate your interest in receiving these (a tick-box slip is provided in the pack).

2.20. Participation is Voluntary
Participation in any research project is voluntary. If you do not wish to take part you are not obliged to.

Your decision whether to take part or not to take part will not affect your relationship with Deakin University.

Before you make your decision, a member of the research team will be available to answer any questions you have about the research project. You can ask for any information you want. Return the questionnaire only after you have had a chance to ask your questions and have received satisfactory answers. Once you have returned your questionnaire, you will be unable to withdraw from the study as all information is anonymous.

2.21. Ethical Guidelines
This project will be carried out according to the National Statement on Ethical Conduct in Human Research (2007) produced by the National Health and Medical Research Council of Australia. This
statement has been developed to protect the interests of people who agree to participate in human research studies.

The ethics aspects of this research project have been approved by the Human Research Ethics Committee of Deakin University.

2.22. Complaints
If you have any complaints about any aspect of the project, the way it is being conducted or any questions about your rights as a research participant, then you may contact:
The Secretary HEAG-H, Dean’s Office, Faculty of Health, Medicine, Nursing and Behavioural Sciences, 221 Burwood Highway, Burwood Victoria 3125, Telephone: 9251 7174, E-mail: hmnbs-research-ethics@deakin.edu.au.

Please quote project number HEAG-H32-2010.

2.23. Reimbursement for your costs
You will not be paid for your participation in this project.

2.24. Further Information, Queries or Any Problems
If you require further information or if you have any problems concerning this project (for example, any side effects), you can contact the principal researcher or associate researchers.

The researchers responsible for this project are:

A/Prof Kylie Ball
Principal Researcher
School of Exercise & Nutrition Sciences
Deakin University
221 Burwood Hwy Burwood
(03) 9251 7310
kball@deakin.edu.au

Ms Megan Teychenne
Associate Researcher
School of Exercise & Nutrition Sciences
Deakin University
221 Burwood Hwy Burwood
(03) 9251 7262
mteych@deakin.edu.au

Prof Jo Salmon
Associate Researcher
School of Exercise & Nutrition Sciences
Deakin University
221 Burwood Hwy Burwood
(03) 9251 7254
jo.salmone@deakin.edu.au
Appendix 28

Key Stakeholders questionnaire for Study 4
The Women’s Activity Study
2010
Thank you for taking the time to complete this survey. As a representative of an organisation that has direct involvement in promoting community health/well-being, your opinions about what strategies would be effective for your community in promoting women’s physical activity are greatly valued. The survey will take you approximately 15 minutes to complete, although this may vary depending on your answers. Once you have finished your survey, please place it in the reply-paid envelope provided and send it back to us. Please note that you do not need a stamp to return the survey.

When marking your answers on the survey, please clearly tick or circle your response so we can easily see which answer you chose. For example:

When asked to tick your answer, please do so like this:

- ☐ Yes
- ☑ No

When asked to circle your answer, please do so like this:

<table>
<thead>
<tr>
<th>Strongly disagree</th>
<th>Disagree</th>
<th>Neither agree nor disagree</th>
<th>Agree</th>
<th>Strongly Agree</th>
<th>Don’t know</th>
<th>Not applicable</th>
</tr>
</thead>
</table>

If you make an error, please clearly cross out the incorrect answer and choose the correct answer. For example:

<table>
<thead>
<tr>
<th>Strongly disagree</th>
<th>Disagree</th>
<th>Neither agree nor disagree</th>
<th>Agree</th>
<th>Strongly Agree</th>
<th>Don’t know</th>
<th>Not applicable</th>
</tr>
</thead>
</table>
Section A  Information booklet

The following section relates to the information booklet ‘Ladies, get active in your neighbourhood’ (provided in the pack). The information booklet provides information about why it is important to be physically active and reduce sitting time, practical ideas to increase levels of physical activity and reduce sitting time, availability of facilities to exercise in the neighbourhood (including women’s only facilities, recreational clubs, exercise options for mums, as well as safer areas to exercise), availability of childcare facilities in the neighbourhood, and contact information for various support groups.

Please read through the information booklet first and then provide us with your feedback by completing this questionnaire.

There are eight questions in this section. Where you are asked to write a written answer please read the question carefully and answer the best you can in the space provided. Where you are asked to provide a ‘rating’ (question A3), please circle the most suitable option on the scale provided.

A1. What do you like about the information booklet?

__________________________________________________________________________________________
__________________________________________________________________________________________
__________________________________________________________________________________________
__________________________________________________________________________________________
__________________________________________________________________________________________
__________________________________________________________________________________________
__________________________________________________________________________________________
__________________________________________________________________________________________

A2. What don’t you like about the information booklet?

__________________________________________________________________________________________
__________________________________________________________________________________________
__________________________________________________________________________________________
__________________________________________________________________________________________
__________________________________________________________________________________________
__________________________________________________________________________________________
__________________________________________________________________________________________
__________________________________________________________________________________________
Please indicate how useful you think the following sections of the information booklet will be for women living in the neighbourhood (Please circle one answer on each line)

<table>
<thead>
<tr>
<th></th>
<th>Information on the health benefits of physical activity <em>(page 2)</em></th>
<th>Not at all useful</th>
<th>Somewhat useful</th>
<th>Useful</th>
<th>Very useful</th>
</tr>
</thead>
<tbody>
<tr>
<td>l.</td>
<td>Tips on how to fit physical activity into daily life <em>(page 3)</em></td>
<td>Not at all useful</td>
<td>Somewhat useful</td>
<td>Useful</td>
<td>Very useful</td>
</tr>
<tr>
<td>m.</td>
<td>Tips on how to reduce daily sitting time <em>(page 4)</em></td>
<td>Not at all useful</td>
<td>Somewhat useful</td>
<td>Useful</td>
<td>Very useful</td>
</tr>
<tr>
<td>n.</td>
<td>Information on places to be physically active in your neighbourhood <em>(page 5)</em></td>
<td>Not at all useful</td>
<td>Somewhat useful</td>
<td>Useful</td>
<td>Very useful</td>
</tr>
<tr>
<td>o.</td>
<td>Information on safer areas to walk in your neighbourhood <em>(page 7)</em></td>
<td>Not at all useful</td>
<td>Somewhat useful</td>
<td>Useful</td>
<td>Very useful</td>
</tr>
<tr>
<td>p.</td>
<td>Information on places to walk your dog in your neighbourhood <em>(page 8)</em></td>
<td>Not at all useful</td>
<td>Somewhat useful</td>
<td>Useful</td>
<td>Very useful</td>
</tr>
<tr>
<td>q.</td>
<td>Information on recreational clubs in your neighbourhood <em>(page 9)</em></td>
<td>Not at all useful</td>
<td>Somewhat useful</td>
<td>Useful</td>
<td>Very useful</td>
</tr>
<tr>
<td>r.</td>
<td>Information on women’s only exercise options in your neighbourhood <em>(page 11)</em></td>
<td>Not at all useful</td>
<td>Somewhat useful</td>
<td>Useful</td>
<td>Very useful</td>
</tr>
<tr>
<td>s.</td>
<td>Information on exercise options for mums <em>(page 12)</em></td>
<td>Not at all useful</td>
<td>Somewhat useful</td>
<td>Useful</td>
<td>Very useful</td>
</tr>
<tr>
<td>t.</td>
<td>Information on childcare facilities in your neighbourhood <em>(page 13)</em></td>
<td>Not at all useful</td>
<td>Somewhat useful</td>
<td>Useful</td>
<td>Very useful</td>
</tr>
<tr>
<td>u.</td>
<td>Information on support groups for those suffering depressive symptoms <em>(page 14)</em></td>
<td>Not at all useful</td>
<td>Somewhat useful</td>
<td>Useful</td>
<td>Very useful</td>
</tr>
</tbody>
</table>
A4. What other information do you think would be useful in motivating women to...
   
   c) Be more active?
   
   d) Sit less?
   
A5. In what way would the information be best delivered? (e.g. monthly instalments in the mail [leaflets] or emails, all at once, a website, an i-phone application etc.)
   
A6. In what ways would the information booklet help women...
   
   c) Be more active?
   
   d) Sit less?
A7. Have you used/been exposed to an information booklet promoting physical activity in your area previously?

<table>
<thead>
<tr>
<th></th>
<th>d. Yes</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>e. No</td>
</tr>
<tr>
<td></td>
<td>f. Not sure</td>
</tr>
</tbody>
</table>

A8. Is there anything else you want to tell us about your thoughts on the information booklet?

___________________________________________________________________________
___________________________________________________________________________
___________________________________________________________________________
___________________________________________________________________________
___________________________________________________________________________

Section B  

Online calendar and diary

The following section relates to the online activity calendar and diary. An example of what the online activity calendar and diary screen may look like is provided in the pack along with step by step instructions. Please use this example as a guide when answering each question. The online activity calendar and diary is a website which allows users to log on and schedule their physical activity goals for the week, month and even year! The user can mark off daily when they have been physically active. At the end of the week, the computer program determines whether the user achieved their physical activity goals and provides feedback for the individual based on what they achieved. There is also an online forum which allows users to chat with other women and share any tips and advice they have for becoming physically active and reducing sitting time. A motivational quote is provided each day to help women achieve their physical activity goals.

Please read over the example of the online activity calendar and diary first and then provide us with your feedback by completing this questionnaire.

There are 10 questions in this section. Where you are asked to write a written answer please read the question carefully and answer the best you can in the space provided. Where you are asked to provide a ‘rating’ (question B3), please circle the most suitable option on the scale provided.

B1. What do you like about the online calendar and diary?
B2. What don’t you like about the online calendar and diary?

__________________________________________________________________________________________
__________________________________________________________________________________________
__________________________________________________________________________________________
__________________________________________________________________________________________
__________________________________________________________________________________________
__________________________________________________________________________________________
__________________________________________________________________________________________
__________________________________________________________________________________________

B3. Please indicate how useful you think the following aspects of the online calendar and diary will be for women in the neighbourhood (Please circle one answer on each line)

<table>
<thead>
<tr>
<th></th>
<th>The daily scheduling of physical activities</th>
<th>Not at all useful1</th>
<th>Somewhat useful2</th>
<th>Useful3</th>
<th>Very useful4</th>
</tr>
</thead>
<tbody>
<tr>
<td>e</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>f</td>
<td>The personalised feedback from the computer regarding achieving your goals</td>
<td>Not at all useful1</td>
<td>Somewhat useful2</td>
<td>Useful3</td>
<td>Very useful4</td>
</tr>
<tr>
<td>g</td>
<td>The daily motivational quotes</td>
<td>Not at all useful1</td>
<td>Somewhat useful2</td>
<td>Useful3</td>
<td>Very useful4</td>
</tr>
<tr>
<td>h</td>
<td>The online forum to share tips and advice for being physically active</td>
<td>Not at all useful1</td>
<td>Somewhat useful2</td>
<td>Useful3</td>
<td>Very useful4</td>
</tr>
</tbody>
</table>

B4. How would the online calendar and diary help women to set physical activity goals?

__________________________________________________________________________________________
__________________________________________________________________________________________
__________________________________________________________________________________________
__________________________________________________________________________________________
__________________________________________________________________________________________
__________________________________________________________________________________________
__________________________________________________________________________________________
__________________________________________________________________________________________
B5. In what ways would the online calendar and diary help women...

c) Be more active?
________________________________________________________
________________________________________________________
________________________________________________________
________________________________________________________
________________________________________________________

d) Sit less?
________________________________________________________
________________________________________________________
________________________________________________________
________________________________________________________

B6. Have you used/been exposed to an online physical activity calendar and diary previously?

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>a</td>
<td>g. Yes</td>
</tr>
<tr>
<td>b</td>
<td>h. No</td>
</tr>
<tr>
<td>c</td>
<td>i. Not sure</td>
</tr>
</tbody>
</table>

B7. Do you have any suggestions to make the online calendar and diary better?
________________________________________________________
________________________________________________________
________________________________________________________
________________________________________________________
________________________________________________________

B8. Which physical activity strategy did you like better and why? (i.e. The Information booklet or the online diary and calendar?)
________________________________________________________
________________________________________________________
________________________________________________________
________________________________________________________


B9. Which physical activity strategy do you think would be more likely to result in an increase in physical activity and a reduction in daily sitting time and why? (i.e. The Information booklet or the online diary and calendar?)

   c) More likely to increase physical activity?

   d) More likely to reduce sitting time?
Thank you very much for taking the time to complete this questionnaire. Your responses will provide valuable information that will help to improve health and increase physical activity amongst women. If you have any other comments, please include them below.

___________________________________________________________________________
___________________________________________________________________________
___________________________________________________________________________
___________________________________________________________________________
___________________________________________________________________________
Appendix 29

Letter of results for Study 4
The Women’s Activity Study

Dear Madam,

A few months ago you participated in the ‘Women’s Activity Study’. A total of 37 women and five key stakeholders participated in this study, providing many interesting insights. Enclosed is a summary of the results from the study for your own interest.

If you have any further questions please contact me on (03) 9251 7262 or mteych@deakin.edu.au.

Many thanks again for participating in this study. Your contribution to this research has been most valuable and will help in the development of programs to increase physical activity and reduce sedentary behaviour amongst women.

Yours sincerely,

Ms Megan Teychenne, PhD Student, School of Exercise & Nutrition Sciences, Deakin University, Burwood
THE WOMEN'S ACTIVITY STUDY

Summary of Results

Information booklet

Most women and key stakeholders were impressed with the booklet and suggested that it was something they would use for future reference. Nearly every woman mentioned that they liked the level of detailed information, with the inclusion of prices, times and contact information. Presentation and local relevance were also suggested to be of importance.

However, a number of women suggested the booklet lacked information relevant to their personal needs and lifestyles. E.g. some women mentioned the times of exercise classes did not fit in their weekly schedule. Other women suggested that more information on age-relevant activities was needed.

Other useful ideas for the booklet included:

- Including weight loss information
- Seasonal suggestions (e.g. tips for winter exercises)
- Including vouchers for the local facilities/classes
- More tips on reducing sitting at home and at work
- More information on the health risks of sitting

Overall, most women mentioned that the booklet was motivational. It increased women’s awareness of available classes, facilities and walking tracks and provided them with good tips to try to be more active and reduce sitting time.

Best delivery method:
Most women felt the booklet would be best delivered as leaflets in the mail. However, other suggestions included:

- A reference book (all information at once)
- Online (website, e-mail, i-phone application)
- All of the above (to suit all age groups and needs)
Online activity calendar

Most women and key stakeholders felt that the online calendar was well presented and looked easy to use. They felt it would help them with setting goals and with monitoring their physical activity. A number of women suggested it was motivational and liked how the program could be tailored to the individual.

However, several women believed the online calendar would be time-consuming and were concerned by how they would feel if they did not achieve their goals. A couple of women also felt the program was condescending.

Some suggestions to improve the online activity calendar included:
- Weight loss information (including a weight tracker)
- Information on local physical activity facilities
- Linking the program to an existing diary system (e.g. outlook, i-phone app)

Preferred Strategy

The information booklet was by far the preferred strategy for women. Reasons included:

- Enjoyment of reading
- Less time-consuming than the online activity calendar
- Useful information and tips to be active

However, a large proportion of women and key stakeholders suggested using the information booklet in conjunction with the online activity calendar would be preferred since each strategy is quite different.

Other suggestions to increase physical activity and reduce sitting

A number of suggestions were mentioned to increase physical activity and reduce sedentary behaviour. These included:

- More social support for physical activity in the community
- Greater accessibility to facilities
- Ensuring the distribution of information on physical activity
Appendix 30

Influences on physical activity and sedentary behaviours, and potential strategies to promote healthy behaviours in disadvantaged women with depressive symptoms (Published abstract).
P22

Development, implementation and preliminary findings of a type 2 diabetes prevention program for Arabic- and Mandarin-speaking communities

K. Naliah1,4, J. Hony1,4, P. Vita1,4, M. Cardona-Morrell1,4, M. Williams1,4, M. Piatarone Singh1,4, S. Colaguarsi1,4

1 Sydney South West Area Health Service, NSW, Australia
2 Sydney School of Public Health, University of Sydney, Australia
3 Faculty of Health Sciences, University of Sydney, Australia
4 Boden Institute of Obesity, Nutrition and Exercise, University of Sydney, Australia

The Sydney Diabetes Prevention Program (SDPP) is the largest community-based diabetes prevention intervention trial in NSW. GPs in three Divisions of General Practice have been engaged to screen and recruit people aged 50–65 years who are at high risk of developing type 2 diabetes. Participants are referred to a lifestyle modification program comprised of an initial consultation, three group sessions and subsequent follow-up telephone calls over the course of 12 months. Each participant contact is designed to improve nutrition, increase physical activity and reduce weight, in order to delay or prevent the onset of type 2 diabetes.

In addition to the mainstream Program, a Culturally and Linguistically Diverse (CALD) stream was developed and implemented targeting Mandarin- and Arabic-speaking participants. An Advisory Group was formed to advise on the adaptation of SDPP to ensure cultural appropriateness of program delivery and resources. Consultation with multicultural health workers was sought where appropriate. Program goals remained the same as the mainstream: to increase physical activity to at least 30 min per day of at least moderate activity; reduce daily fat intake; reduce daily saturated fat intake; increase daily fibre intake; and reduce body weight by 5% over the length of the program.

A number of differences were found between the recruitment processes and characteristics of the CALD and mainstream participants.

doi:10.1016/j.orcp.2010.09.023

P23

Influences on physical activity and sedentary behaviours, and potential strategies to promote healthy behaviours in disadvantaged women with depressive symptoms

M. Teychenne*, K. Ball, J. Salmon

School of Exercise and Nutrition Sciences, Deakin University, Australia

Physical activity (PA) reduces the risk of depression as well as obesity, conditions which are more prevalent amongst socio-economically disadvantaged women. However, disadvantaged women with depressive symptoms are at a high risk of being physically inactive and engaging in sedentary behaviour (SB). Therefore, it is important to understand the influences on PA and SB, as well as identify strategies aimed to promote PA and reduce SB amongst this population group.

18 women experiencing depressive symptoms and living in disadvantaged neighbourhoods (aged 18–45) participated in one-on-one semi-structured telephone interviews, following the Social Ecological Framework. Depressive symptoms were assessed using the Centre for Epidemiologic Studies Depression Scale (CES-D 10). Thematic data analyses were performed.

Although women mentioned finding it difficult to be physically active feeling down, they did recognise the impact exercising had on managing depressive symptoms. Other influences on PA included feeling tired, lack of time, negative atmospheres of recreational clubs, having children, social support, cost, and safety in the neighbourhood. Women mentioned using television (TV) as a tool for “switching off” when feeling depressed. Influences on SB included childhood TV habits and having children. Potential strategies that were suggested to increase PA and reduce SB included multi-tasking/time management, public awareness campaigns, childcare facilities, family and friend support, mothers PA groups, provision of information on available facilities, and women’s only gyms/classes.

These findings could inform future intervention strategies to increase PA and reduce SB for disadvantaged women with depressive symptoms. Such strategies are also likely to reduce the risk of obesity amongst this high-risk target group.

doi:10.1016/j.orcp.2010.09.024
Appendix 31

The SocioEconomic Status and Activity in Women (SESAW) Study

(Sections used in analyses)
PART 5: TIME SPENT SITTING

The next questions are about the time you spend sitting while at work, at home, while doing study, and during leisure time. This may include time spent sitting at a desk, visiting friends, reading or sitting or lying down to watch television or sitting in a motor vehicle.

Q28. During the last 7 days, how much time did you usually spend sitting on a weekday (INCLUDING the day and evening)?

_______ hours per weekday ________ minutes per weekday

Q29. During the last 7 days, how much time did you usually spend sitting on a weekend day (INCLUDING the day and evening)?

_______ hours per weekend day ________ minutes per weekend day

In the times you spent sitting, we are interested in finding out the types of activities you did.

Q30. Of your total sitting time, during the last 7 days, how much time did you usually spend sitting watching TV on a weekday?

_______ hours per weekday ________ minutes per weekday

Q31. Of your total sitting time, during the last 7 days, how much time did you usually spend sitting watching TV on a weekend day?

_______ hours per weekend day ________ minutes per weekend day

Q32. Of your total sitting time, during the last 7 days, how much time did you usually spend sitting at a computer on a weekday?

_______ hours per weekday ________ minutes per weekday

Q33. Of your total sitting time, during the last 7 days, how much time did you usually spend sitting at a computer on a weekend day?

_______ hours per weekend day ________ minutes per weekend day

Q34. Which of the following best describes your physical activity levels as a child, say age 10? (Please tick one only).

I was much less active than other girls my age 1
I was less active than other girls my age 2
I was about as active as other girls my age 3
I was more active than other girls my age 4
I was much more active than other girls my age 5
Q35. How confident are you that you could walk for exercise or recreation, in each of the following situations? (Please tick one on each line).

<table>
<thead>
<tr>
<th></th>
<th></th>
<th>Not at all confident</th>
<th>Slightly confident</th>
<th>Moderately confident</th>
<th>Very confident</th>
<th>Extremely confident</th>
</tr>
</thead>
<tbody>
<tr>
<td>a</td>
<td>Go for a walk even when I am tired</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>b</td>
<td>Go for a walk even when I am in a bad mood</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>c</td>
<td>Go for a walk even when I feel I don't have time</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>d</td>
<td>Go for a walk even when I am on vacation</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>e</td>
<td>Go for a walk even when it is raining</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
</tbody>
</table>

Feelings about watching television:

<table>
<thead>
<tr>
<th></th>
<th></th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>I hate it</th>
</tr>
</thead>
<tbody>
<tr>
<td>a</td>
<td>I enjoy it</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>I hate it</td>
</tr>
<tr>
<td>b</td>
<td>I feel interested</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>I feel bored</td>
</tr>
<tr>
<td>c</td>
<td>I find it pleasurable</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>I find it unpleasurable</td>
</tr>
<tr>
<td>d</td>
<td>It's a lot of fun</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>It's no fun at all</td>
</tr>
<tr>
<td>e</td>
<td>I find it energising</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>I find it tiring</td>
</tr>
<tr>
<td>f</td>
<td>It makes me happy</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>It makes me depressed</td>
</tr>
<tr>
<td>g</td>
<td>I feel good while doing it</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>I feel bad while doing it</td>
</tr>
<tr>
<td>h</td>
<td>I am not at all frustrated by it</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>I am very frustrated by it</td>
</tr>
<tr>
<td>i</td>
<td>It gives me a strong sense of accomplishment</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>It does not give me any sense of accomplishment</td>
</tr>
<tr>
<td>j</td>
<td>I feel as though there is nothing else I would rather be doing</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>I feel as though I would rather be doing something else</td>
</tr>
</tbody>
</table>
**PREFERRED ACTIVITIES**

If you were able to choose to do DIFFERENT TYPES of activities at different times of the day, which would you most prefer to do?

We want you to think about the following:

**VIGOROUS** physical activities like cycling, jogging, aerobics, swimming etc;

**MODERATE** physical activities like brisk walking, digging in the garden, washing & waxing the car, raking leaves etc; &

**SEDENTARY (SITTING/LYING DOWN)** recreational pastimes like watching television, reading a book, resting, relaxing, talking on the phone etc.

NOTE: If you do not work outside the home, please think about your time outside of your other daily commitments.

Q36. In the morning before work or other commitments, which one of the following would you most prefer to do if you had your choice? (Please tick one only)

<table>
<thead>
<tr>
<th>Vigorous physical activities</th>
<th>Moderate physical activities</th>
<th>Sedentary pastimes</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
</tbody>
</table>

Q37. During your lunch break at work or from other commitments, which one of the following would you most prefer to do if you had your choice? (Please tick one only).

<table>
<thead>
<tr>
<th>Vigorous physical activities</th>
<th>Moderate physical activities</th>
<th>Sedentary pastimes</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
</tbody>
</table>

Q38. When you finish work at the end of the day, which one of the following would you most prefer to do if you had your choice? (Please tick one only).

<table>
<thead>
<tr>
<th>Vigorous physical activities</th>
<th>Moderate physical activities</th>
<th>Sedentary pastimes</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
</tbody>
</table>

Q39. When you have some free-time on the weekend, which one of the following would you most prefer to do if you had your choice? (Please tick one only).

<table>
<thead>
<tr>
<th>Vigorous physical activities</th>
<th>Moderate physical activities</th>
<th>Sedentary pastimes</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
</tbody>
</table>
Q40. How often does each of the following things interfere with or prevent you from exercising or being physically active? *(Please tick one circle on each line).*

<table>
<thead>
<tr>
<th></th>
<th>Never</th>
<th>Rarely</th>
<th>Sometimes</th>
<th>Fairly often</th>
<th>Very often</th>
</tr>
</thead>
<tbody>
<tr>
<td>a</td>
<td>Others discourage me</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>b</td>
<td>No one to exercise with</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>c</td>
<td>Self-conscious</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>d</td>
<td>Feel too overweight</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>e</td>
<td>No safe place</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>f</td>
<td>No facilities/equipment in my local neighbourhood</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>g</td>
<td>No facilities/equipment at my workplace</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>h</td>
<td>Lack of skills</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>i</td>
<td>Lack of knowledge on how to exercise</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>j</td>
<td>No childcare</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>k</td>
<td>Not in good health</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>l</td>
<td>No energy</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>m</td>
<td>Get enough exercise at my job</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>n</td>
<td>No motivation</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>o</td>
<td>No self-discipline</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>p</td>
<td>Not organised enough</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>q</td>
<td>Do not like exercise</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>r</td>
<td>Can’t afford it/too expensive</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>s</td>
<td>Do not have time</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
</tbody>
</table>

Q41. During the past year, how often did members of your family (including partner/spouse): *(Please tick one on each line)*

<table>
<thead>
<tr>
<th></th>
<th>Never</th>
<th>Rarely</th>
<th>A few times</th>
<th>Often</th>
<th>Very often</th>
</tr>
</thead>
<tbody>
<tr>
<td>a</td>
<td>Do physical activity with you?</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>b</td>
<td>Encourage you to be physically active?</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
</tbody>
</table>

Q42. During the past year, how often did friends or work colleagues: *(Please tick one on each line)*

<table>
<thead>
<tr>
<th></th>
<th>Never</th>
<th>Rarely</th>
<th>A few times</th>
<th>Often</th>
<th>Very often</th>
</tr>
</thead>
<tbody>
<tr>
<td>a</td>
<td>Do physical activity with you?</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>b</td>
<td>Encourage you to be physically active?</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
</tbody>
</table>
Q43. To what extent do you agree or disagree with each of the following statements about walking in your neighbourhood?
(Remember, by ‘your local neighbourhood’ we mean the local area within about 2 kilometres of your home, which is about 15-20 minutes walk or 5 minutes drive)

*(Please tick one circle on each line)*

<p>| | | | | | | |</p>
<table>
<thead>
<tr>
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<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>a</td>
<td>I have access to places to walk for exercise or recreation in my local neighbourhood</td>
<td>Strongly disagree</td>
<td>Disagree</td>
<td>Neither agree nor disagree</td>
<td>Agree</td>
<td>Strongly agree</td>
</tr>
<tr>
<td>b</td>
<td>I have access to places to do vigorous physical activities in my local neighbourhood</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>c</td>
<td>Shops are in walking distance</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>d</td>
<td>It is safe out walking day or night</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>e</td>
<td>I often see neighbours out on walks</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>f</td>
<td>The neighbourhood is friendly</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>g</td>
<td>I have someone to walk with around the neighbourhood</td>
<td></td>
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</tr>
<tr>
<td>h</td>
<td>My spouse/partner likes walking in the neighbourhood</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>i</td>
<td>My neighbourhood is attractive</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>j</td>
<td>There are pleasant walks to do</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>k</td>
<td>The neighbourhood is safe for walking</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>l</td>
<td>The neighbourhood is well maintained</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>m</td>
<td>There are busy roads to cross when out on walks</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>n</td>
<td>Dogs frighten people who walk around the neighbourhood</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>o</td>
<td>There is a lot of traffic in the neighbourhood</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>p</td>
<td>There are footpaths on most of the streets in your neighbourhood</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>q</td>
<td>The footpaths are in good condition</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>r</td>
<td>The streets are well lit at night</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>s</td>
<td>There are interesting walks to do</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>t</td>
<td>A park is within walking distance from my home</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Q44. We are interested in knowing about the facilities for physical activity in your local neighbourhood. Please tick TWO circles on each line – one about whether this is within walking distance from your home, and the second about whether you have used it in the past TWO WEEKS.

<table>
<thead>
<tr>
<th>Facility</th>
<th>Are the following within walking distance from your home?</th>
<th>Have you used the following facilities for physical activity in the past two weeks?</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Yes₁</td>
<td>No₂</td>
</tr>
<tr>
<td>Football field</td>
<td></td>
<td></td>
</tr>
<tr>
<td>a Beach</td>
<td></td>
<td></td>
</tr>
<tr>
<td>b Golf course</td>
<td></td>
<td></td>
</tr>
<tr>
<td>c Gym/health club/exercise/sport centre</td>
<td></td>
<td></td>
</tr>
<tr>
<td>d Public open space (eg park, oval)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>e Walking/bike paths</td>
<td></td>
<td></td>
</tr>
<tr>
<td>f River</td>
<td></td>
<td></td>
</tr>
<tr>
<td>g Public swimming pool</td>
<td></td>
<td></td>
</tr>
<tr>
<td>h Public tennis courts</td>
<td></td>
<td></td>
</tr>
<tr>
<td>i Squash courts</td>
<td></td>
<td></td>
</tr>
<tr>
<td>j Courts/facilities for indoor sports (eg netball, indoor cricket)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

For example: if you have a football field within walking distance, but you haven’t used it in the last two weeks, you would respond:

Q45. These questions ask about your feelings and thoughts during the LAST MONTH. Please indicate with a tick how often you felt or thought a certain way. (Please tick one on each line)

<table>
<thead>
<tr>
<th>Feeling</th>
<th>Never₁</th>
<th>Almost never₂</th>
<th>Sometimes₃</th>
<th>Fairly often₄</th>
<th>Very often₅</th>
</tr>
</thead>
<tbody>
<tr>
<td>a Felt that you were unable to control the important things in your life?</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>b Felt confident about your ability to handle your personal problems?</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>c Felt that things were going your way?</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>d Felt difficulties were piling up so high that you could not overcome them?</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Q46. Are the following within walking distance from your home? *(Please tick all that apply)*

<table>
<thead>
<tr>
<th></th>
<th>Yes₁</th>
<th>No₂</th>
<th>Don't know₃</th>
</tr>
</thead>
<tbody>
<tr>
<td>a</td>
<td>Clothing Shops</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>b</td>
<td>Schools</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>c</td>
<td>Chemist/Pharmacies</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>d</td>
<td>Banks/Building Societies/Credit Unions</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>e</td>
<td>Playgrounds</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>f</td>
<td>Libraries</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>g</td>
<td>Video Stores</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>h</td>
<td>Movie Cinema</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>i</td>
<td>Milk bar</td>
<td>○</td>
<td>○</td>
</tr>
</tbody>
</table>

Q47. How many of your neighbours do you know by name? *(Please tick one only)*

<table>
<thead>
<tr>
<th>None₁</th>
<th>1 – 2₂</th>
<th>3 – 4₃</th>
<th>5 – 6₄</th>
<th>7 or more₅</th>
</tr>
</thead>
<tbody>
<tr>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
</tbody>
</table>

Q48. How much do you agree or disagree with the following statements: *(Please tick one circle on each line).*

<table>
<thead>
<tr>
<th></th>
<th>Strongly disagree₁</th>
<th>Disagree₂</th>
<th>Neither agree or disagree₃</th>
<th>Agree₄</th>
<th>Strongly agree₅</th>
</tr>
</thead>
<tbody>
<tr>
<td>a</td>
<td>Most people can be trusted</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>b</td>
<td>You can't be too careful dealing with people</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>c</td>
<td>Most of the time people try to be helpful</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>d</td>
<td>People are mostly looking out for themselves</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>e</td>
<td>People in this neighbourhood can be trusted</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>f</td>
<td>This is a close-knit neighbourhood</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>g</td>
<td>People around here are willing to help their neighbours</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>h</td>
<td>People in this neighbourhood generally don't get along with each other</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>i</td>
<td>People in this neighbourhood do not share the same values</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
</tbody>
</table>
Q49. How often have you done any of the following activities in the past 12 months? *(Please tick one circle on each line)*

<table>
<thead>
<tr>
<th></th>
<th>Visited family or had family visit</th>
<th>Visited friends or had friends visit</th>
<th>Visited neighbours or had neighbours visit</th>
<th>Been to a café or restaurant</th>
<th>Been to a social club</th>
<th>Been to the cinema or theatre</th>
<th>Been to a party or dance</th>
<th>Played sport</th>
<th>Been to the gym or exercise class</th>
<th>Been to a class (e.g., cooking, language)</th>
<th>Been involved in a hobby group</th>
<th>Singing/acting/musician in a group</th>
<th>Been involved in a self-help or support group</th>
</tr>
</thead>
<tbody>
<tr>
<td>a</td>
<td></td>
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<td></td>
<td></td>
<td></td>
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<td></td>
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<tr>
<td>b</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>c</td>
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</tr>
</tbody>
</table>

Q50. Would you say your health is: *(Please tick one only).*

<table>
<thead>
<tr>
<th></th>
<th>Excellent 1</th>
<th>Very good 2</th>
<th>Good 3</th>
<th>Fair 4</th>
<th>Poor 5</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
</tbody>
</table>

Q51. Do you have a serious illness, long-term injury or disability that prevents you from being physically active? *(Please tick one only).*

<table>
<thead>
<tr>
<th></th>
<th>Yes 1</th>
<th>No 2</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>O</td>
<td>O</td>
</tr>
</tbody>
</table>
Q52. How much do you currently weigh, without clothes or shoes?
   _____ kg  or  _____ pounds

Q53. How tall are you (without shoes)?
   _____ cm  or  _____ feet  _____ inches

Q54. Which of the following best describes you at the moment? (Please tick one only).
   
   I am actively doing things to try to **gain weight** at the moment  O 1
   I am actively doing things to try to **avoid gaining weight** at the moment  O 2
   I am actively doing things to try to **lose weight** at the moment  O 3
   I am **not doing anything** in particular for my weight at the moment  O 4

Q55. Are you currently pregnant? (Please tick one only).
   
   Yes 1  No 2  Don’t know 3
   O  O  O

Q56. Have you reached menopause? (Please tick one only).
   
   Yes 1  No 2  Don’t know 3
   O  O  O

Q57. Which of the following best describes your current smoking status? (Please tick one only)
   
   I have never smoked 1  I used to smoke 2  I now smoke occasionally 3  I now smoke regularly 4
   O  O  O  O
**Q58.** Have you recently (for example, in the last couple of weeks): *(Please tick one circle on each line)*

<table>
<thead>
<tr>
<th></th>
<th>Better than usual</th>
<th>Same as usual</th>
<th>Less than usual</th>
</tr>
</thead>
<tbody>
<tr>
<td>a</td>
<td>Been able to concentrate on whatever you’re doing?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>b</td>
<td>Felt on the whole you were doing things well?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>c</td>
<td>Been able to feel warmth and affection for those near to you?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>d</td>
<td>Been finding it easy to get on with other people?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>e</td>
<td>Lost much sleep over worry?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>f</td>
<td>Felt constantly under strain?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>g</td>
<td>Felt you couldn’t overcome your difficulties?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>h</td>
<td>Been feeling unhappy and depressed?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>i</td>
<td>Been losing confidence in yourself?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>j</td>
<td>Been thinking of yourself as a worthless person?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>k</td>
<td>Been taking things hard?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>l</td>
<td>Found everything getting on top of you?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>m</td>
<td>Been feeling nervous and strung-up all the time?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>n</td>
<td>Found at times you couldn’t do anything because your nerves were too bad?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>o</td>
<td>Been having restless, disturbed nights?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>p</td>
<td>Been finding life a struggle all the time?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>q</td>
<td>Been getting scared or panicky for no good reason?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>r</td>
<td>Felt that life is entirely hopeless?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>s</td>
<td>Felt that life isn’t worth living?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>t</td>
<td>Felt that you are playing a useful part in things?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>u</td>
<td>Felt capable of making decisions about things?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>v</td>
<td>Been able to enjoy your normal day-to-day activities?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>w</td>
<td>Been feeling reasonably happy, all things considered?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>x</td>
<td>Been able to face up to your problems?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>y</td>
<td>Been feeling hopeful about your own future?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>z</td>
<td>Been managing to keep yourself busy and occupied?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>aa</td>
<td>Been getting out of the house as much as usual?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>bb</td>
<td>Spent much time chatting with people?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>cc</td>
<td>Been satisfied with the way you’ve carried out your tasks?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>dd</td>
<td>Been managing as well as most people would in your shoes?</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
You and your life

Q59. What is your date of birth? (Please write on the line)

___/___/19___ (dd/mm/19yy)

Q60. In which country were you born? (Please tick one only).

- Australia 1
- UK 2
- Italy 3
- Greece 4
- New Zealand 5
- Vietnam 6
- Other 7

If you were born in Australia,

Q61. When did you first arrive in Australia with the intention to stay? (Please tick one only).

- Before 1950 1
- 1950-1970 2
- 1970-1990 3
- After 1990 4

Q62. Which of the following best describes your current relationship status? (Please tick one only)

- Living in a registered marriage 1
- Living in a de facto relationship 2
- Separated 3
- Divorced 4
- Widowed 5
- Never married 6
Q63. How many people live with you now? *(Please tick all that apply).*

<table>
<thead>
<tr>
<th></th>
<th>One₁</th>
<th>Two₂</th>
<th>Three or more₃</th>
</tr>
</thead>
<tbody>
<tr>
<td>a</td>
<td>No one, I live alone</td>
<td>O₁</td>
<td></td>
</tr>
<tr>
<td>b</td>
<td>Partner or spouse</td>
<td>O₂</td>
<td></td>
</tr>
<tr>
<td>c</td>
<td>Children under 2 years</td>
<td></td>
<td>O₂</td>
</tr>
<tr>
<td>d</td>
<td>Children under 10 years</td>
<td></td>
<td>O₂</td>
</tr>
<tr>
<td>e</td>
<td>Children under 16 years</td>
<td></td>
<td>O₂</td>
</tr>
<tr>
<td>f</td>
<td>Children 16-18 years</td>
<td></td>
<td>O₂</td>
</tr>
<tr>
<td>g</td>
<td>Children over 18 years</td>
<td></td>
<td>O₂</td>
</tr>
<tr>
<td>h</td>
<td>Your parents or in-laws</td>
<td></td>
<td>O₂</td>
</tr>
<tr>
<td>i</td>
<td>Other adult relatives</td>
<td></td>
<td>O₂</td>
</tr>
<tr>
<td>j</td>
<td>Other adults (not family members)</td>
<td></td>
<td>O₂</td>
</tr>
</tbody>
</table>

Q64. What is the HIGHEST qualification you, and your partner/spouse if applicable, have completed? *(Please tick one in each column: one for you, and one for your partner/spouse. If you do not have a spouse/partner please leave this column blank.)*

<table>
<thead>
<tr>
<th>Qualification</th>
<th>Self a</th>
<th>Partner/ Spouse b</th>
</tr>
</thead>
<tbody>
<tr>
<td>No formal qualifications</td>
<td>O₁</td>
<td>O₁</td>
</tr>
<tr>
<td>Year 10 or equivalent (e.g. School Certificate)</td>
<td>O₂</td>
<td>O₂</td>
</tr>
<tr>
<td>Year 12 or equivalent (e.g. Higher School Certificate)</td>
<td>O₃</td>
<td>O₃</td>
</tr>
<tr>
<td>Trade/apprenticeship (e.g. hairdresser, chef)</td>
<td>O₄</td>
<td>O₄</td>
</tr>
<tr>
<td>Certificate/diploma (e.g. childcare, technician)</td>
<td>O₅</td>
<td>O₅</td>
</tr>
<tr>
<td>University degree</td>
<td>O₆</td>
<td>O₆</td>
</tr>
<tr>
<td>Higher University degree (e.g. Graduate Diploma, Masters, PhD)</td>
<td>O₇</td>
<td>O₇</td>
</tr>
</tbody>
</table>
Q65. What is the HIGHEST qualification your mother and father, or main caregivers, completed? *(Please tick one in each column: one for your mother/main female caregiver, and one for your father/main male caregiver)*

<table>
<thead>
<tr>
<th>Qualification</th>
<th>Mother/ main female caregiver</th>
<th>Father/ main male caregiver</th>
</tr>
</thead>
<tbody>
<tr>
<td>No formal qualifications</td>
<td>☐ 1</td>
<td>☐ 1</td>
</tr>
<tr>
<td>Year 10 or equivalent (eg. School Certificate)</td>
<td>☐ 2</td>
<td>☐ 2</td>
</tr>
<tr>
<td>Year 12 or equivalent (eg. Higher School Certificate)</td>
<td>☐ 3</td>
<td>☐ 3</td>
</tr>
<tr>
<td>Trade/apprenticeship (eg. hairdresser, chef)</td>
<td>☐ 4</td>
<td>☐ 4</td>
</tr>
<tr>
<td>Certificate/diploma (eg. childcare, technician)</td>
<td>☐ 5</td>
<td>☐ 5</td>
</tr>
<tr>
<td>University degree</td>
<td>☐ 6</td>
<td>☐ 6</td>
</tr>
<tr>
<td>Higher University degree (eg. Graduate Diploma, Masters, PhD)</td>
<td>☐ 7</td>
<td>☐ 7</td>
</tr>
<tr>
<td>No mother/female caregiver</td>
<td>☐ 8</td>
<td></td>
</tr>
<tr>
<td>No father/male caregiver</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Don’t know</td>
<td>☐ 9</td>
<td>☐ 9</td>
</tr>
</tbody>
</table>

Q66. Which of the following best describes your current main daily activities and/or responsibilities, and those of your spouse/partner? *(Please tick one in each column: one for you and one for your spouse/partner. If you do not have a spouse/partner please leave this column blank.)*

<table>
<thead>
<tr>
<th>Activity</th>
<th>Self</th>
<th>Spouse</th>
</tr>
</thead>
<tbody>
<tr>
<td>Working full-time</td>
<td>☐ 1</td>
<td>☐ 1</td>
</tr>
<tr>
<td>Working part-time</td>
<td>☐ 2</td>
<td>☐ 2</td>
</tr>
<tr>
<td>Unemployed or laid off</td>
<td>☐ 3</td>
<td>☐ 3</td>
</tr>
<tr>
<td>Looking for work</td>
<td>☐ 4</td>
<td>☐ 4</td>
</tr>
<tr>
<td>Keeping house and/or raising children full-time</td>
<td>☐ 5</td>
<td>☐ 5</td>
</tr>
<tr>
<td>Studying full-time</td>
<td>☐ 6</td>
<td>☐ 6</td>
</tr>
<tr>
<td>Retired</td>
<td>☐ 7</td>
<td>☐ 7</td>
</tr>
</tbody>
</table>
Q67. What is your main occupation, and, if applicable, that of your spouse/partner? *(Please tick one in each column: one for you and one for your spouse/partner. If you do not have a spouse/partner please leave this column blank.)*

<table>
<thead>
<tr>
<th>Role Description</th>
<th>Self</th>
<th>Partner/Spouse</th>
</tr>
</thead>
<tbody>
<tr>
<td>Manager or administrator (eg magistrate, farm manager, own business, media producer, general manager, director of nursing, school principal)</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Professional (eg accountant, doctor, registered nurse, allied health professional, teacher, artist)</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Associate professional (eg technician, office manager, branch manager, shop manager, tennis coach, retail buyer, youth worker, police officer)</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Tradesperson or related worker (eg sign writer, cook, dressmaker, hairdresser, gardener, florist)</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>Advanced clerical or service worker (eg bookkeeper, credit officer, radio dispatcher, secretary, personal assistant, flight attendant, law clerk)</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>Intermediate clerical, sales or service worker (eg accounts clerk, checkout supervisor, typist, word processing/data entry operator, receptionist, child care worker, nursing assistant, hospitality worker)</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>Intermediate production or transport worker (eg sewing machinist, machinery operator, bus driver)</td>
<td>7</td>
<td>7</td>
</tr>
<tr>
<td>Elementary clerical, sales or services worker (eg filing/mail clerk, parking inspector, sales assistant, telemarketer, housekeeper)</td>
<td>8</td>
<td>8</td>
</tr>
<tr>
<td>Labourer or related worker (eg cleaner, factory worker, general farm hand, kitchen hand, fast food cook)</td>
<td>9</td>
<td>9</td>
</tr>
<tr>
<td>No paid job</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>Student</td>
<td>11</td>
<td>11</td>
</tr>
</tbody>
</table>

Q68. What is the average gross *(before tax)* income that you and your household receive each week, including wages, salary, pensions and allowances? *(Please tick one in each column: one for yourself and one for your household)*

<table>
<thead>
<tr>
<th>Income Range</th>
<th>Self</th>
<th>Household</th>
</tr>
</thead>
<tbody>
<tr>
<td>No income</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>$1-$119 per week ($1-$6,239 annually)</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>$120-$299 per week ($6,240-$15,999 annually)</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>$300-$499 per week ($16,000-$25,999 annually)</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>$500-$699 per week ($26,000-$36,999 annually)</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>$700-$999 per week ($37,000-$51,999 annually)</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>$1,000-$1,499 per week ($52,000-$77,999 annually)</td>
<td>7</td>
<td>7</td>
</tr>
<tr>
<td>$1,500 or more per week ($78,000 or more annually)</td>
<td>8</td>
<td>8</td>
</tr>
<tr>
<td>Don't know</td>
<td>9</td>
<td>9</td>
</tr>
<tr>
<td>Don't want to answer</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>Household income is the same as mine</td>
<td>11</td>
<td>11</td>
</tr>
</tbody>
</table>
Appendix 32

Physical activity and likelihood of depression in adults: A review

(Published manuscript)
Review
Physical activity and likelihood of depression in adults: A review

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Available online 26 January 2008

Abstract

Objective. This review examines original research which has investigated associations between physical activity (PA) dose (i.e. frequency, intensity and duration) and domain and depression or symptoms of depression in adults.

Methods. A search of electronic databases and authors’ own bibliographic libraries was performed between 2006 and 2007 for original research articles investigating associations between PA and depression in adults. A total of 27 observational and 40 intervention studies were included.

Results. Of the studies that focused on the association between duration of PA and likelihood of depression, all five observational studies, and five of the seven intervention studies found both shorter and longer durations of PA were associated with reduced likelihood of depression. Of the studies that focused on the association between intensity of PA and likelihood of depression, four of the six observational studies found that vigorous-intensity PA was more strongly associated with decreased likelihood of depression than lower intensities. Most intervention studies showed that both intensities were effective in reducing the likelihood of depression. Two observational studies found a stronger inverse relationship of leisure-time PA with depression than PA in other domains. There is insufficient evidence regarding the importance of the PA setting on depression.

Conclusion. Although the dose and domain of physical activity varied across studies reviewed, evidence suggests that even low doses of PA may be protective against depression. Further studies examining the optimal domain of PA for reducing the likelihood of depression are needed.

Keywords: Physical activity; Mental health; Depression; Dose; Domain

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Introduction

Depression affects more than 340 million people worldwide (Greden, 2001) and is the number one cause of non-fatal disease affliction in Australia (Mathers and Stevenson, 1999). Depression has become the leading cause of disability in the developed world (Lopez et al., 2006) and by 2020 it has been predicted to be the second leading cause of disability, next to cardiovascular disease in the developing world (Murray and Lopez, 1997). Clinical depression is characterized by the presence of various signs and symptoms which severely affect one’s mood and daily functioning (Commonwealth Department of Health and Aged Care, 1999a). Non-clinical depressive symptoms are also very common in many populations (Commonwealth Department of Health and Aged Care [CDHAC], 1999a; US Department of Health and Human Services [USDHHS], 1999; The Centre for Economic Performance’s Mental Health Policy Group, 2006). Typical management of depression has often involved treatment from clinical professionals such as general practitioners, psychiatrists and psychologists, and has included counselling and anti-depressant medication (CDHAC, 1999a). Recent research, however, has focused on the potential role of physical activity in the prevention and/or management of depression and depressive symptoms (Paluska and Schwenk, 2000).

A number of countries, including the UK, US and Australia, have developed health-related physical activity guidelines, which generally recommend that all adults accumulate at least 30 min of moderate-intensity physical activity on most, if not all days of the week (CDHAC, 1999b; American College of Sports Medicine [ACSM], 2000; Chief Medical Officer’s Report [CMOR], 2004). These guidelines were developed to improve population health and to prevent diseases such as type 2 diabetes and coronary heart disease (Saxena et al., 2005). However, there has been relatively little systematic examination of the optimal dose of physical activity that is required to prevent depression.

Several reviews of the literature have focused on observational and intervention studies which have assessed the relationship between physical activity and depression (O’Neal et al., 2000; Brosse et al., 2002; Lotan et al., 2005; Penedo and Dahn, 2005; Saxena et al., 2005; Paluska and Schwenk, 2000; Lawlor and Hopker, 2001; Craft and Perna, 2004). These reviews generally draw a similar conclusion: that physical activity is positively associated with better mental health, with only one review suggesting that a strong conclusion could not be made due to methodological limitations of the studies examined (Lawlor and Hopker, 2001). However, past reviews have not intended to specifically examine the association between physical activity dose (i.e. frequency, duration, intensity), domain (i.e. domestic, leisure-time, work-related and transport-related physical activity), or setting (i.e. home-based or centre-based) and likelihood of depression. It is important to examine such components of physical activity and their relationship with depression in order to inform public health clinical recommendations regarding the specific amounts, contexts and settings of physical activity most likely to reduce the likelihood of depression.

This literature review will examine original research assessing the associations between physical activity and depression. A particular focus will be on identifying the optimal dose, domain and setting of physical activity most consistently associated with reduction in likelihood of depression.

Methods

Search strategy

A detailed search of electronic databases was performed for original research articles published post-1980. These databases included: MEDLINE (via Pub Med), PsychINFO, Science Direct and Expanded Academic Index. and seven bibliographic libraries were also searched. The following search terms were used to identify relevant articles: depression, mental health, physical activity, exercise, dose, intensity, duration, frequency, domain, leisure-time, occupation, domestic, transport, and adults. Reference lists of relevant studies and literature reviews were further examined, as well as links to related articles in electronic databases. Approximately 100 articles were initially identified as potentially fulfilling the selection criteria. After screening full papers according to the selection criteria, a total of 27 (13 cross-sectional and 14 longitudinal) observational and 40 intervention studies were included in this review.

Inclusion/exclusion criteria

Types of studies

This review includes studies presented in previous literature reviews (O’Neal et al., 2000; Paluska and Schwenk, 2000; Lawlor and Hopker, 2001; Brosse et al., 2002; Craft and Perna, 2004; Lotan et al., 2005; Penedo and Dahn, 2005; Saxena et al., 2005), and new studies identified or undertaken since these reviews. Observational (cross-sectional and longitudinal) and intervention (including non-Randomized Controlled Trials [non-RCT’s] as well as Randomized Controlled Trials [RCT’s]) studies were included in this review; however, studies published before 1980, as well as abstracts and dissertations were excluded.
Participants
The focus of this review was on adults, as depression has been found to be more common in adulthood than in childhood (Copeland, 1996), with the prevalence of depression increasing with age (Stordal et al., 2003). Additionally, few studies have focused specifically on the association between physical activity and depression in children/adolescents (Curtin and Perrin, 2006). Therefore, only studies including adults were selected for review. However, three studies in the current review included adolescents (aged 10–17) as well as adults in their sample (Stephens et al., 1998; Wyremb, 1992; Goodwin et al., 2003). Healthy adults as well as those experiencing depressive symptoms or clinical depression were included in the review (see sample in Tables 1 and 2).

Predictor and outcome measures
All studies included in this review were required to incorporate at least one indicator of likelihood of depression as well as an indicator of physical activity dose (i.e., frequency, duration, intensity of weekly physical activity), or domain (i.e., domestic, leisure-time, work-related and transport-related physical activity) or setting (i.e., home or centre-based). All studies were required to examine the association(s) between physical activity and likelihood of depression.

Analyses of published studies
Study methodologies
Studies identified in this review were examined according to several methodological variables (where reported), including: type of study (cross-sectional, longitudinal, intervention [RCT or non-RCT], sample size, age, community or clinical), frequency of physical activity (assessments/week), duration of physical activity (minutes or hours/week), intensity of physical activity (light, moderate, vigorous), domain of physical activity (leisure-time, transport-related, domestic, work-related), and the setting of activity in intervention studies (centre-based, home-based). RCT’s in this review included both healthy and clinically depressed adults in control groups with depression generally being measured at baseline and immediately after the trial. Results were examined in terms of the statistical relationship of dose, domain or setting of physical activity with likelihood of depression (see Tables 1 and 2). Effect sizes for RCT’s that reported a significant p-value ($p<0.05$) and included intervention and control group means (SD) at baseline and post-intervention or the F statistic were also calculated.

Results
Observational studies
Twenty-seven observational studies were identified (Table 1). Most of the studies comprised non-clinical community samples of adults (aged 18–89), predominately from the US. In general, self-report measures were used in order to assess depression and physical activity. The methods for assessing depression included well-validated measures such as the Centre for Epidemiologic Studies Depression Scale [CESD-S] (Radloff, 1977), the General Health Questionnaire [GHQ] (Goldberg, 1972), the Beck Depression Inventory [BDI] (Beck and Steer, 1978) and the Profile of Mood States [POMS] (McNair et al., 1971). Physical activity was typically assessed using measures such as the validated Physical Activity Index (Young et al., 1995). Several studies, however, used measures which have not been validated (Farnett et al., 1988; Knouse et al., 1993; Goodwin, 2003).

Intervention studies
A total of 40 intervention studies were identified (Table 2). Participants in these studies included both the clinically depressed (as diagnosed by health professionals) and non-clinical samples of adults (aged 17+), predominately from the US. Depression was assessed using self-report measures including the CESD-S (Radloff, 1977), Hamilton Rating Scale for Depression (Hedrington and Vieweg, 1979), POMS (McNair et al., 1971) and the BDI (Beck and Steer, 1978). Physical activity was assessed according to the specific details of the interventions (e.g., duration, frequency and intensity prescribed).

For those RCTs that reported a significant effect of physical activity on depression or symptoms of depression, the effect size ranged from 0.05 to 1.75. Sufficient information to calculate effect size was provided by 13 studies (Anderson et al., 1999; Blumenhal et al., 1989; Dillorenzo et al., 1999; Doyme et al., 1987; Dunn et al., 2005; McCann and Holmes, 1984; McNair et al., 1991; Moses et al., 1989; Mutrie, 1989; Ruth and Holmes, 1987; Singh et al., 1997; Singh et al., 2001; Steptoe et al., 1989).

Of those studies, four showed a small effect size, three showed a medium effect size, and five showed a large effect size. One study included a physical activity intervention which showed a large and a medium effect size, dependent on the exercise condition.

How much physical activity?
Observational studies
Four observational studies provided sufficient information comparing different weekly doses of physical activity (Thirlaway and Benten, 1992; Paffenbarger et al., 1994; Hassmen et al., 2000; Brown et al., 2005; Wise et al., 2006). All five studies concluded that both higher and lower levels of physical activity were associated with a decreased likelihood of depression. For example, one study found that as little as 1 h and as much as 7 h of physical activity/week was associated with a reduced likelihood of depression (Wise et al., 2006), whilst another study found that undertaking as little as 20 min and as much as 1 h of physical activity/week was associated with a reduced likelihood of depression (Thirlaway and Benten, 1992). However, Hassmen et al. (2000) found that undertaking 20–30 min of physical activity 2–3 times/week week was more strongly associated with reduced likelihood of depression than undertaking lower or higher doses of physical activity. The remaining 21 studies were unable to be interpreted according to the exact dose of physical activity as they did not provide sufficient information (e.g. on frequency and duration, or total weekly time) to indicate a total weekly dose.
<table>
<thead>
<tr>
<th>Author, year and country</th>
<th>Type of study</th>
<th>Sample</th>
<th>Duration/frequency</th>
<th>Intensity</th>
<th>Domain</th>
<th>Relationship with depression</th>
<th>Identified in (previous review)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bailey and McLaren (2005); Australia</td>
<td>Cross-sectional</td>
<td>194 retired adults, mean age 66</td>
<td>Frequency and duration not stated</td>
<td>Not stated</td>
<td>Combined LTPA and sedentary work-related</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Bernaards et al. (2006); Netherlands</td>
<td>Longitudinal</td>
<td>1747 workers, aged 18–59</td>
<td>Less than once a month, 1–3 times/month, 1–2 times/week.</td>
<td>Vigorous</td>
<td>LTPA</td>
<td>0</td>
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</tr>
<tr>
<td>Bhui and Fletcher (2000); UK</td>
<td>Longitudinal</td>
<td>5352 men and women, aged 18+</td>
<td>Duration not stated</td>
<td>Vigorous</td>
<td>LTPA</td>
<td>0</td>
<td>Brose et al. (2002)</td>
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<tr>
<td>Brown et al. (2000); Australia</td>
<td>Cross-sectional</td>
<td>39,532 women, aged 18–75</td>
<td>Frequency not stated</td>
<td>Not stated</td>
<td>Combined LTPA and sedentary work-related</td>
<td>0</td>
<td>O’Neal et al. (2000)</td>
</tr>
<tr>
<td>Brown et al. (2005); Australia</td>
<td>Longitudinal</td>
<td>9207 women, aged 45–50</td>
<td>Frequency not stated</td>
<td>Not stated</td>
<td>Combined LTPA and sedentary work-related</td>
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<td>Camacho et al. (1991); US</td>
<td>Longitudinal</td>
<td>5000 men and women, aged 20+</td>
<td>‘Low levels’</td>
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<td>Combined LTPA and sedentary work-related</td>
<td>0</td>
<td>O’Neal et al. (2000); Brose et al. (2002)</td>
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<td>Cooper-Patrick et al. (1987); US</td>
<td>Longitudinal</td>
<td>752 former medical students, age not stated</td>
<td>Frequency not stated</td>
<td>Not stated</td>
<td>Combined LTPA and sedentary work-related</td>
<td>0</td>
<td>O’Neal et al. (2000)</td>
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<td>DeForge et al. (1989); US</td>
<td>Cross-sectional</td>
<td>86 elderly osteoarthritis patients, aged 60–89</td>
<td>Frequency not stated</td>
<td>Not stated</td>
<td>Combined LTPA and sedentary work-related</td>
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<td>Brose et al. (2002)</td>
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<td>Farmer et al. (1988); US</td>
<td>Longitudinal</td>
<td>1900 healthy adults, aged 25–77</td>
<td>‘Low levels’</td>
<td>Not stated</td>
<td>LTPA</td>
<td>0</td>
<td>O’Neal et al. (2000); Brose et al. (2002); Paloska and Schwenk (2000)</td>
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<tr>
<td>Study (Year)</td>
<td>Design</td>
<td>Sample Size</td>
<td>Frequency and Duration</td>
<td>Activity Level</td>
<td>Notes</td>
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<td>Galper et al. (2006); US</td>
<td>Cross-sectional</td>
<td>6728 men and women, aged 20–88</td>
<td>20+ miles/week</td>
<td>Not stated</td>
<td>LTPA</td>
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<td>Goodwin (2003); US</td>
<td>Cross-sectional</td>
<td>8098 adults, aged 15–54</td>
<td>‘Regular’. Frequency and duration not stated</td>
<td>Not stated</td>
<td>Combined LTPA and work-related</td>
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<td>Harris et al. (2006); US</td>
<td>Longitudinal</td>
<td>424 clinically depressed patients, aged 18+</td>
<td>‘Higher levels’. Frequency and duration not stated</td>
<td>Not stated</td>
<td>LTPA</td>
<td></td>
<td></td>
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<tr>
<td>Hassmen et al. (2000); Finland</td>
<td>Cross-sectional</td>
<td>3403 men and women, aged 25–64</td>
<td>20–30 min daily</td>
<td>Moderate–vigorous</td>
<td>LTPA</td>
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<tr>
<td>Krause et al. (1993); Japan</td>
<td>Cross-sectional</td>
<td>1351 older adults, aged 60+</td>
<td>Frequency and duration not stated</td>
<td>Not stated</td>
<td>Combined LTPA and domestic</td>
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<tr>
<td>Kreis-Silverstein et al. (2001); US</td>
<td>Cross-sectional and longitudinal study</td>
<td>11900 middle classed men and women, aged 50–89</td>
<td>3+ times/week</td>
<td>Not stated</td>
<td>Cross-sectional only</td>
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<td>Kall (2002); Estonia</td>
<td>Cross-sectional</td>
<td>659 women, aged 18–45</td>
<td>1–2 times/week</td>
<td>Moderate–vigorous</td>
<td>LTPA</td>
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<td>Lampinen et al. (2000); Finland</td>
<td>Longitudinal</td>
<td>663 adults, aged 65+</td>
<td>Frequency and duration not stated</td>
<td>Light</td>
<td>Domestic</td>
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<tr>
<td>Lee and Russell (2003); Australia</td>
<td>Longitudinal</td>
<td>10,063 older women, aged 70–78</td>
<td>0–1 times/week</td>
<td>Light</td>
<td>LTPA</td>
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<td>Lindwall et al. (2007); Sweden</td>
<td>Cross-sectional</td>
<td>860 older adults (mean age = 75)</td>
<td>1–3 times/month</td>
<td>Vigorous</td>
<td>LTPA</td>
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<tr>
<td>Moli et al. (1996); US</td>
<td>Longitudinal</td>
<td>2084 older adults, aged 65+</td>
<td>‘Low’</td>
<td>Light</td>
<td>LTPA</td>
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<tr>
<td>Moore et al. (1999); US</td>
<td>Cross-sectional</td>
<td>146 clinically depressed older adults, aged 50+</td>
<td>‘Moderate’</td>
<td>Moderate</td>
<td>LTPA</td>
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<tr>
<td>Paffenburger et al. (1994); US</td>
<td>Longitudinal</td>
<td>21,569 men, aged 35–74</td>
<td>Not stated</td>
<td>Light (walk)</td>
<td>Combined LTPA and transport</td>
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<td></td>
</tr>
</tbody>
</table>

(continued on next page)
<table>
<thead>
<tr>
<th>Author, year and country</th>
<th>Type of study</th>
<th>Sample</th>
<th>Duration/frequency</th>
<th>Intensity</th>
<th>Domain</th>
<th>Relationship with depression</th>
<th>Identified in (previous review)</th>
</tr>
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<tr>
<td>Ruuskanen and Ruoppila (1995); Finland</td>
<td>Cross-sectional</td>
<td>1,244 older adults, aged 65–84</td>
<td>‘Low’</td>
<td>Light</td>
<td>Combined domestic and transport</td>
<td>0</td>
<td>Brosse et al. (2002)</td>
</tr>
<tr>
<td>Stephens (1988); Canada</td>
<td>Cross-sectional</td>
<td>A total of 55,979 individuals, aged 10+</td>
<td>‘Regular’. Frequency and duration not stated; ‘Much exercise’; ‘Much exercise’; ‘Moderate exercise’. ‘Little/no exercise’. Frequency and duration not stated</td>
<td>Moderate–vigorous</td>
<td>LTPA</td>
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<tr>
<td>Thirlaway and Benton (1992); UK</td>
<td>Cross-sectional</td>
<td>246 white-collar workers, aged 18–63</td>
<td>20–60 min/week; 60+ min/week</td>
<td>Not stated</td>
<td>LTPA</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>Weyerer (1992); Germany</td>
<td>Cross-sectional and longitudinal</td>
<td>1,536 men and women, aged 15+</td>
<td>‘Regular exercise’. Frequency and duration not stated</td>
<td>Not stated</td>
<td>LTPA</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>Wise et al. (2006); US</td>
<td>Longitudinal</td>
<td>35,224 African-American women, aged 21–69</td>
<td>1 h/week; 3–4 h/week; 7+ h/week; 1–7 h/week. Frequency not stated</td>
<td>Vigorous</td>
<td>LTPA</td>
<td>–</td>
<td>–</td>
</tr>
</tbody>
</table>

LTPA, leisure-time physical activity.
0 = no relationship, and – = inverse relationship.
remainder, five studies found that both high and low levels of physical activity were associated with a reduced likelihood of depression (Klein et al., 1985; Emery and Blumenthal, 1988; Blumenthal et al., 1989; King et al., 1993; DiLorenzo et al., 1999), whilst one study found no association between physical activity and depression, regardless of the dose prescribed (Brown et al., 1995).

A total of 13 studies prescribed a total weekly duration of physical activity (refer to Table 2) equivalent to the recommended public health dose of >150 min/week, with seven finding a relationship with decreased depressive symptoms (Martinson et al., 1985, 1989; Emery and Blumenthal, 1988; Blumenthal et al., 1989; King et al., 1993; DiLorenzo et al., 1999; Nabkasorn et al., 2005). Twelve intervention studies prescribed between 90–150 min of physical activity/week (Doyne et al., 1983; McCann and Holmes, 1984; Klein et al., 1985; McNeil et al., 1991; Gitlin et al., 1992; Brown et al., 1995; Anderson et al., 1999; Blumenthal et al., 1999; Babyak et al., 2000; Dimeo et al., 2001; Mather et al., 2002; Motl et al., 2005), with 10 of those studies finding an inverse relationship with likelihood of depression (Doyne et al., 1983; McCann and Holmes, 1984; Klein et al., 1985; McNeil et al., 1991; Anderson et al., 1999; Blumenthal et al., 1999; Babyak et al., 2000; Dimeo et al., 2001; Mather et al., 2002; Motl et al., 2005).

Of the nine studies which implemented interventions requiring participants to undertake less than 90 min of physical activity/week, eight showed an association with decreased likelihood of depression (Fremont and Craighead, 1987; Roth and Holmes, 1987; Mutrie, 1989; Siette et al., 1989; Norvell et al., 1991; Singh et al., 1997, 2001; Annese et al., 2004), with one study reporting psychological benefits in participants undertaking as little as 40 min physical activity/week (Annese et al., 2004). A total of six intervention studies did not provide information on the duration and/or frequency of physical activity, and therefore the total weekly dose could not be determined (Doyne et al., 1987; Sim, 1987; Veale et al., 1992; McCafferty et al., 2004; West et al., 2004; Dunn et al., 2005).

What intensity of physical activity?

Observational studies

A total of six observational studies examined the association between various intensities of physical activity and depression (Rauskanen and Ruoppila, 1995; Bhu and Fletcher, 2000; Lampinen et al., 2000; Lee and Russel, 2003; Lindwall et al., 2007; Wise et al., 2006). Of those studies, four concluded that vigorous-intensity physical activity was more strongly associated with decreased likelihood of depression than physical activity of lower intensities (Rauskanen and Ruoppila, 1995; Lampinen et al., 2000; Lee and Russel, 2003; Wise et al., 2006). For example, Lampinen et al. (2000) found that what they categorized as a decreased intensity of physical activity over eight years was significantly associated with increasing depressive symptoms. However, Lindwall et al. (2007) found significant associations between light-intensity physical activity and likelihood of depression in women only, and vigorous-intensity physical activity and likelihood of depression in men only. Conversely, Bhu and Fletcher (2000) found no association between physical activity of any intensity and depression.

Intervention studies

A total of 12 intervention studies specifically compared physical activity intensities and their association with likelihood of depression (Klein et al., 1985; Doyne et al., 1987; Emery and Blumenthal, 1988; Blumenthal et al., 1989; Moses et al., 1989; Veale et al., 1992; King et al., 1993; Brown et al., 1995; DiLorenzo et al., 1999; West et al., 2004; Dunn et al., 2005; Motl et al., 2005). Six studies directly compared light- and moderate-intensity physical activity (Emery and Blumenthal, 1988; Blumenthal et al., 1989; Brown et al., 1995; West et al., 2004; Dunn et al., 2005; Motl et al., 2005). Only one of those studies found a difference in association between intensities, with only moderate-intensity physical activity being strongly associated with a reduced likelihood of depression (Dunn et al., 2005). Of the remaining five studies, four found that both light and moderate intensities were inversely associated with likelihood of depression (Emery and Blumenthal, 1988; Blumenthal et al., 1989; West et al., 2004; Motl et al., 2005), with one study finding no association between any intensity of physical activity and depression (Brown et al., 1995). A total of four studies directly compared moderate- and vigorous-intensity physical activity (Doyne et al., 1987; King et al., 1993; Moses et al., 1989; DiLorenzo et al., 1999), with one of those studies finding effects on depression only for moderate-intensity physical activity (Moses et al., 1989) but the remaining three finding that both moderate- and vigorous-intensity physical activity reduced symptoms of depression (Doyne et al., 1987; DiLorenzo et al., 1999; King et al., 1993). Two intervention studies compared the effect of light- and vigorous-intensity physical activity on depressive symptoms (Klein et al., 1985; Veale et al., 1992) with only one study finding an inverse association between both intensities of physical activity and depression (Klein et al., 1985).

Domain and setting of physical activity

Observational studies

Most observational studies examined relationships between leisure-time physical activity and depression in adults, with those studies generally concluding that leisure-time physical activity was positively associated with lower likelihood of depression (refer to Table 1). A total of seven observational studies included leisure-time physical activity as well as physical activity from other domains (e.g. work-related and domestic) in a ‘total’ physical activity measure (Stephens, 1988; Camacho et al., 1991; Krause et al., 1993; Paffenbarger et al., 1994; Bhu and Fletcher, 2000; Goodwin, 2003; Bailey and McLaren, 2005). Six of these seven studies found a significant association between the total physical activity measure and likelihood of depression (Stephens, 1988; Camacho et al., 1991; Krause et al., 1993; Paffenbarger et al., 1994; Bhu and Fletcher, 2000; Goodwin, 2003). Although no comparisons were specifically made between each individual domain of physical activity in these studies, one study did compare leisure-time physical activity with a combination of leisure-time and domestic physical activity (Stephens, 1988). It found a stronger association between leisure-time physical activity and likelihood of depression than the combination of leisure-time and domestic physical activity and risk of depression.
<table>
<thead>
<tr>
<th>Author, year and country</th>
<th>Type of study</th>
<th>Sample</th>
<th>Duration/Intensity</th>
<th>Total weekly duration</th>
<th>Intensity</th>
<th>Domain</th>
<th>Relationship with depression</th>
<th>Effect size</th>
<th>Identified in (previous review)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anderson et al. (1999); US</td>
<td>Non-RCT</td>
<td>40 obese, sedentary women, aged 21–60</td>
<td>40 min, 2 times/week</td>
<td>30–45 min, 3 times/week</td>
<td>Moderate</td>
<td>LTPA</td>
<td>--</td>
<td>0.3</td>
<td>Palaska and Schweng (2000)</td>
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<tr>
<td>Arntz et al. (2004); US</td>
<td>RCT</td>
<td>101 healthy adults, mean age = 67</td>
<td>3 h</td>
<td>60 min, 3 times/week</td>
<td>Moderate</td>
<td>LTPA</td>
<td>--</td>
<td>0.6</td>
<td>Brosse et al. (2002); Palaska and Schweng (2000)</td>
</tr>
<tr>
<td>Blumenthal et al. (1989); US</td>
<td>RCT</td>
<td>156 depressed patients, aged over 50</td>
<td>1.5 h</td>
<td>30 min, 3 times/week</td>
<td>Moderate</td>
<td>LTPA</td>
<td>--</td>
<td>Insufficient data</td>
<td>Brosse et al. (2002); Saxena et al. (2005); Lawlor and Hopker (2001); Craft and Perna (2004)</td>
</tr>
<tr>
<td>Babyak et al. (2000); US</td>
<td>RCT follow-up</td>
<td>156 depressed patients, aged over 50</td>
<td>1.5 h</td>
<td>30 min, 3 times/week</td>
<td>Moderate</td>
<td>LTPA</td>
<td>--</td>
<td>Insufficient data</td>
<td></td>
</tr>
<tr>
<td>Brown et al. (1999); US</td>
<td>Non-RCT</td>
<td>114 healthy sedentary adults, aged 40–60</td>
<td>2–2.5 h</td>
<td>45 min, 5 times/week</td>
<td>Light</td>
<td>LTPA</td>
<td>0</td>
<td>NA</td>
<td>Brosse et al. (2002)</td>
</tr>
<tr>
<td>Cramer et al. (1989); US</td>
<td>RCT</td>
<td>30 mildly obese women, aged 25–45</td>
<td>3.75 h</td>
<td>24 min, 4 times/week</td>
<td>Moderate</td>
<td>LTPA</td>
<td>0</td>
<td>NA</td>
<td>Palaska and Schweng (2000)</td>
</tr>
<tr>
<td>Dimeo et al. (2001); Germany</td>
<td>Non-RCT</td>
<td>12 men and women with clinical depression, aged 20–65</td>
<td>1.5 h</td>
<td>60 min, 2 times/week</td>
<td>Moderate</td>
<td>LTPA</td>
<td>0</td>
<td>NA</td>
<td>Craft and Perna (2004)</td>
</tr>
<tr>
<td>Doyne et al. (1983); US</td>
<td>RCT</td>
<td>4 clinically depressed women, aged 19–24</td>
<td>2 h</td>
<td>30 min, 4 times/week</td>
<td>Moderate</td>
<td>LTPA</td>
<td>--</td>
<td>Insufficient information</td>
<td>O'Neal et al. (2000); Palaska and Schweng (2000); Brosse et al. (2002); Saxena et al. (2005); Lawlor and Hopker (2001); Craft and Perna (2004)</td>
</tr>
<tr>
<td>Doyne et al. (1987); US</td>
<td>RCT</td>
<td>10 station, 4 times/week</td>
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<td>Moderate</td>
<td>LTPA</td>
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<td>1.2</td>
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<tr>
<td>Dunn et al. (2005); US</td>
<td>RCT</td>
<td>80 men and women with mild–moderate Major Depressive Disorder, aged 20–45</td>
<td>Not stated</td>
<td>Not stated</td>
<td>Moderate</td>
<td>LTPA</td>
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<td>0.7</td>
<td>Brosse et al. (2002); Saxena et al. (2005); Lawlor and Hopker (2001); Craft and Perna (2004)</td>
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<td>Study</td>
<td>Design</td>
<td>Participants</td>
<td>Duration/Intervention</td>
<td>Outcome</td>
<td>LTPA</td>
<td>Notes</td>
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<td>Emery and Blumenthal (1988)</td>
<td>US</td>
<td>73 men, aged 31–59, 35–60 min, minimum 3 times/wk, 1.75–3 h</td>
<td>Moderate (aerobic)</td>
<td>LTPA</td>
<td>NA</td>
<td>Brosse et al. (2002); Palaska and Schwenk (2000)</td>
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<tr>
<td>Emery and Blumenthal (1990)</td>
<td>US</td>
<td>48 older adults, mean age=72, 1 h, 3 times/wk, 1.6–2.5 h</td>
<td>Light-moderate (strength/flexibility)</td>
<td>LTPA</td>
<td>NA</td>
<td>O’Neal et al. (2000); Lawlor and Hopker (2001); Brosse et al. (2002)</td>
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<tr>
<td>Gittlin et al. (1992)</td>
<td>US</td>
<td>267 healthy elderly volunteers, aged 60–89, 40 min, 3 times/wk, 2 h</td>
<td>Moderate</td>
<td>LTPA</td>
<td>NA</td>
<td>Brosse et al. (2002)</td>
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<td>Hughes et al. (1986)</td>
<td>US</td>
<td>Randomized cross-over trial, 14 men, average age=33, 3.75 h, Moderate</td>
<td>LTPA</td>
<td>NA</td>
<td></td>
<td>Brosse et al. (2002)</td>
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<tr>
<td>King et al. (1989)</td>
<td>US</td>
<td>120 sedentary adults, mean age=48, 40–62 min, 3.3–5.2 h</td>
<td>Moderate</td>
<td>LTPA</td>
<td>NA</td>
<td>Brosse et al. (2002)</td>
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<tr>
<td>King et al. (1993)</td>
<td>US</td>
<td>357 healthy men and women, aged 50–65, 60 min, 3 times/wk, 3 h</td>
<td>Vigorous</td>
<td>LTPA</td>
<td></td>
<td>Brosse et al. (2002)</td>
<td></td>
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<tr>
<td>Klein et al. (1985)</td>
<td>US</td>
<td>74 men and women, mean age=50, 60 min, 3 times/wk, 3 h</td>
<td>Vigorous</td>
<td>LTPA</td>
<td></td>
<td>Brosse et al. (2002); Lawlor and Hopker (2001)</td>
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<tr>
<td>Martinez et al. (1985)</td>
<td>Norway</td>
<td>49 clinically depressed patients, aged 17–60, 1 h, 3 times/wk, 3 h</td>
<td>Moderate–vigoroiu</td>
<td>LTPA</td>
<td></td>
<td>Brosse et al. (2002); Palaska and Schwenk (2000); O’Neal et al. (2000)</td>
<td></td>
<td></td>
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<tr>
<td>Martinez et al. (1989)</td>
<td>Norway</td>
<td>99 clinically depressed patients, mean age=41, 60 min, 3 times/wk, 3 h</td>
<td>Moderate (aerobic)</td>
<td>LTPA</td>
<td>NA</td>
<td>Brosse et al. (2002); Palaska and Schwenk (2000); O’Neal et al. (2000)</td>
<td></td>
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<tr>
<td>Mather et al. (2002)</td>
<td>UK</td>
<td>86 older adults, aged 53+, 1 h, 2 times/wk, 2 h</td>
<td>Weight bearing</td>
<td>LTPA</td>
<td></td>
<td>Brosse et al. (2002)</td>
<td></td>
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</tr>
<tr>
<td>McCann and Holmes (1984)</td>
<td>US</td>
<td>43 college females, age not assessed, 1 h, 2 times/wk, 2 h</td>
<td>Moderate–vigoroiu</td>
<td>LTPA</td>
<td></td>
<td>Brosse et al. (2002); Palaska and Schwenk (2000); O’Neal et al. (2000)</td>
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<tr>
<td>McLaugherty et al. (2004)</td>
<td>US</td>
<td>28 healthy, older adults, aged 60–77, 3 times/wk, Not stated</td>
<td>Moderate (resistance)</td>
<td>LTPA</td>
<td>NA</td>
<td>Brosse et al. (2002); Lawlor and Hopker (2001); Penedo and Dahn (2005)</td>
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<tr>
<td>McNiel et al. (1991)</td>
<td>Canada</td>
<td>30 older adults, mean age=73, 3 times/wk, 1–2 h</td>
<td>Light–moderate</td>
<td>LTPA</td>
<td>1.0</td>
<td>Brosse et al. (2002); Lawlor and Hopker (2001); Penedo and Dahn (2005)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Author, year and country</td>
<td>Type of study</td>
<td>Sample</td>
<td>Duration/frequency</td>
<td>Total weekly duration</td>
<td>Intensity</td>
<td>Domain</td>
<td>Relationship with depression</td>
<td>Effect size</td>
<td>Identified in (previous review)</td>
</tr>
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<tr>
<td>Moses et al. (1989); UK</td>
<td>RCT</td>
<td>109 sedentary adults, aged 18–60</td>
<td>20 min, 4 times/week 30 min, 4 times/week</td>
<td>1.3 h</td>
<td>Moderate</td>
<td>LTPA</td>
<td>–</td>
<td>0.23</td>
<td>Paluska and Schwenk (2000)</td>
</tr>
<tr>
<td>Motl et al. (2005); US</td>
<td>Non-RCT</td>
<td>174 men and women, aged 60–75</td>
<td>15–45 min, 3 times/week</td>
<td>45 min – 2.25 h</td>
<td>Light-moderate (walking)</td>
<td>LTPA</td>
<td>–</td>
<td>NA</td>
<td></td>
</tr>
<tr>
<td>Maitie (1989); UK</td>
<td>RCT</td>
<td>36 patients, mean age = 42</td>
<td>20 min, 3 times/week</td>
<td>1 h</td>
<td>Moderate (aerobic)</td>
<td>LTPA</td>
<td>–</td>
<td>0.67*</td>
<td>Lawlor and Hopker (2001)</td>
</tr>
<tr>
<td>Nakhavorns et al. (2005); Thailand</td>
<td>Randomised cross-over trial</td>
<td>49 females with mild–moderate depressive symptoms, aged 18–29</td>
<td>50 min, 5 times/week</td>
<td>4.2 h</td>
<td>Light-moderate</td>
<td>LTPA</td>
<td>–</td>
<td>NA</td>
<td></td>
</tr>
<tr>
<td>Nieman et al. (2000); US Norvell et al. (1991); US</td>
<td>RCT</td>
<td>30 obese women, aged 25–79</td>
<td>45 min, 5 times/week</td>
<td>3.75 h</td>
<td>Moderate</td>
<td>LTPA</td>
<td>0</td>
<td>NA</td>
<td></td>
</tr>
<tr>
<td>Palmer (1995); US</td>
<td>RCT</td>
<td>43 sedentary women, mean age = 58</td>
<td>30 min, 2 times/week</td>
<td>1 h</td>
<td>Moderate–vigorous</td>
<td>LTPA</td>
<td>–</td>
<td>Insufficient information</td>
<td>Brosse et al. (2002); Paluska and Schwenk (2000) Brosse et al. (2002)</td>
</tr>
<tr>
<td>Roth and Holmes (1987); US Sime (1987); US</td>
<td>RCT</td>
<td>55 college students, mean age = 19</td>
<td>30 min, 3 times/week</td>
<td>1.5 h</td>
<td>Moderate–vigorous</td>
<td>LTPA</td>
<td>–</td>
<td>0.2</td>
<td>Brosse et al. (2002) Paluska and Schwenk (2000)</td>
</tr>
<tr>
<td>Singh et al. (1997); US</td>
<td>RCT</td>
<td>15 moderately depressed adults, aged 26–53</td>
<td>Duration not stated</td>
<td>Not stated</td>
<td>Vigorous</td>
<td>LTPA</td>
<td>–</td>
<td>NA</td>
<td></td>
</tr>
<tr>
<td>Singh et al. (2001); US (follow-up)</td>
<td>RCT</td>
<td>32 older adults with major or minor depression, mean age = 71</td>
<td>45 min, 3 times/week</td>
<td>1.5 h</td>
<td>Vigorous (resistance)</td>
<td>LTPA</td>
<td>–</td>
<td>0.67</td>
<td></td>
</tr>
<tr>
<td>Steptoe et al. (1989); UK</td>
<td>RCT</td>
<td>53 previously inactive adults with symptoms of anxiety, aged 20–60</td>
<td>20 min, 4 times/week</td>
<td>1.3 h</td>
<td>Moderate</td>
<td>LTPA</td>
<td>–</td>
<td>0.05</td>
<td></td>
</tr>
<tr>
<td>Veale et al. (1992); UK</td>
<td>RCT</td>
<td>83 men and women, aged 18–60</td>
<td>3 times/week 3 times/week</td>
<td>Not stated</td>
<td>Moderate–vigorous Light</td>
<td>LTPA</td>
<td>0</td>
<td>NA</td>
<td>Brosse et al. (2002)</td>
</tr>
<tr>
<td>West et al. (2004); US</td>
<td>Non-RCT</td>
<td>69 healthy college students, aged 17–24</td>
<td>Duration not stated</td>
<td>Not stated</td>
<td>Moderate (dance) Light (yoga)</td>
<td>LTPA</td>
<td>–</td>
<td>NA</td>
<td>Penedo and Dahn (2005)</td>
</tr>
</tbody>
</table>

RCT, Randomized Controlled Trial; Non-RCT, non-Randomized Controlled Trial; LTPA, leisure-time physical activity; NA, not assessable.

0 = no relationship; – = inverse relationship; *data from 4-week mid-intervention.
Only two observational studies specifically compared leisure-time physical activity with physical activity in other domains (Ruuskanen and Ruoppila, 1995; Lampinen et al., 2000). One study compared leisure-time physical activity with domestic physical activity (Lampinen et al., 2000), whilst the other compared leisure-time physical activity with a combination of domestic and transport-related physical activity (Ruuskanen and Ruoppila, 1995). Although both studies found a significant relationship between physical activity in different domains (domestic and leisure-time physical activity) and depressive symptoms, a stronger inverse association between leisure-time physical activity and likelihood of depression was evident.

**Intervention studies**

All interventions involved leisure-time physical activity, but varied in terms of the setting in which the leisure-time physical activity took place. A total of 36 intervention studies examined the effectiveness of structured centre-based physical activity training programs on alleviating symptoms of depression. The overall findings were that in general, depression scores were reduced after participating in structured exercise interventions at an exercise centre. Three studies conducted interventions using home-based physical activity programs (King et al., 1989; Moses et al., 1989; Steptoe et al., 1989). Two of the three studies concluded that a reduction in depressive symptoms was related to participation in the home-based physical activity interventions (Moses et al., 1989; Steptoe et al., 1989). Only one intervention study specifically compared home-based physical activity with a centre-based physical activity program (King et al., 1993). That study found that physical activity was significantly associated with alleviating depressive symptoms regardless of the setting, as no differences were seen between the group undertaking the home-based intervention and the group undertaking the centre-based intervention. No intervention studies focusing on physical activity in domains other than leisure-time were identified.

**Discussion**

This literature review examined evidence of a relationship between physical activity and likelihood of depression. This review differs from previous published reviews as it examined the specific dose, domain and setting of physical activity associated with risk of depression. Nearly all of the observational studies in this review (25 out of 27) and the majority of the intervention studies (31 out of 40) reported an inverse relationship between physical activity and depression. A total of 20 out of the 31 effective intervention studies were RCT’s. It is important to note that of the eight intervention studies that found no significant association between physical activity and depression, seven of those were RCT’s. However, this was the only major difference found when comparing results of non-RCT’s with results of RCT’s. Although eight out of 13 RCT’s reported a medium to large effect on depression or symptoms of depression, some depressive symptoms are somatic in nature (e.g. disturbed sleep, general fatigue, diminished appetite); therefore, improvements in depressive symptoms might reflect the general benefits of exercise without any direct impact on depression per se. This review also highlights the fact that although numerous studies focusing on the relationship between physical activity and likelihood of depression have been undertaken, research gaps still exist, in particular, understanding the association between physical activity components (dose, domain and setting) and likelihood of depression.

While much of the evidence reviewed supported the benefits of a higher dose of physical activity, similar to that recommended in the national physical activity guidelines (i.e. 30 min of moderate-intensity physical activity on most, if not all days of the week) (CDHAC, 1999b), support was also obtained for much lower doses, with benefits seen when undertaking as little as 20–60 min physical activity/week (Thirlaway and Benton, 1992; Annesi et al., 2004).

Review findings suggest that there may not be an optimal intensity for reducing likelihood of depression. Previous reviews have also suggested that the intensity of physical activity may not be an important factor in reducing depressive symptoms, as benefits were seen in studies prescribing a range of intensities (Paluska and Schwenk, 2000; Craft and Perna, 2004). However, this has not previously been investigated systematically. Of the eight out of 40 intervention studies that found no significant relationship between physical activity and depression (Cramer et al., 1991; Hughes et al., 1986; King et al., 1989; Emery and Gatz, 1990; Gitlin et al., 1992; Brown et al., 1995; Palmer, 1995; Nieman et al., 2000), all studies included physical activity interventions of a light to moderate intensity, suggesting that higher intensities of physical activity may be more effective in reducing the risk of depression. Nevertheless, other RCT’s (McNeil et al., 1991) and non-RCT’s (Motl et al., 2005; West et al., 2004) that included light-intensity activities did produce evidence for the inverse relationship between physical activity and risk of depression, and therefore other explanations for the lack of associations observed in these seven intervention studies should be considered. For example, in the studies that did not show a relationship between physical activity and depression (Cramer et al., 1991; Hughes et al., 1986; King et al., 1989; Emery and Gatz, 1990; Gitlin et al., 1992; Brown et al., 1995; Palmer, 1995; Nieman et al., 2000; Veale et al., 1992), all but one included non-clinically depressed participants (Cramer et al., 1991; Hughes et al., 1986; King et al., 1989; Emery and Gatz, 1990; Gitlin et al., 1992; Brown et al., 1995; Palmer, 1995; Nieman et al., 2000), which may produce a “floor effect” as there is less room for improvement in depression in such samples (Brosse et al., 2002).

Furthermore, most of the observational and intervention studies which examined physical activity intensity in this review assessed physical activity of different durations and therefore it may be difficult to differentiate the effects of intensity from the effects of duration, which is potentially a limitation of this review. The measures of intensity in the study by Lampinen et al. (2000) were only defined in terms of types of activities (e.g. light intensity = necessary chores), rather than more direct measures such as perceived intensity, METs, or percentage of maximum heart rate. Buij and Fletcher (2000) found no association between physical activity and intensity and depression, which may be due to methodological weaknesses; for example, it was not stated whether the physical activity measures were validated.
studies with valid physical activity measures are needed to specifically compare physical activity interventions of varying intensities, by matching on duration or on total energy expenditure, to determine optimal intensity.

Several hypotheses have been proposed to explain the association between physical activity intensity and reduced likelihood of depression. One recent theoretical framework has attempted to explain and contextualize the affective (i.e., mood and emotional) relationship between physical activity and depression, using a multi-dimensional perspective by considering individuals’ responses to various intensities of physical activity (Ekkkekakis et al., 2005). It suggests that moderate-intensity exercise will be associated with positive affect (pleasure), whilst vigorous intensities will be associated with negative affect (displeasure) (Ekkkekakis et al., 2005). Further, this framework suggests that when the intensity of physiological activity is at the level between these two intensities (approximating the transition from aerobic to anaerobic metabolism), affective responses will vary (involving pleasure or displeasure), depending on individuals’ cognitive response and also preference (Ekkkekakis et al., 2005; Lind et al., 2005). This theory is contrary to traditional theories such as the ‘Inverted U hypothesis’, which assumes that moderate–vigorous intensity physical activity optimizes conditions for positive affective changes regardless of individual variability (Berger and Mott, 2000). Thus, acknowledging individuality (i.e. affect responses and preference to activities) may be important to consider in the development of strategies for promoting physical activity and reducing the likelihood of depression.

This review showed that studies investigating the association between physical activity and depression have generally assessed only leisure-time physical activity. Very little research has investigated the association of likelihood of depression with other domains of activity, such as work-related, transport-related or domestic physical activity. This is important given that the current public health physical activity recommendations promoted in most developed countries (CDHAC, 1999b; ACSM, 2000; CMOR, 2004) focus on movement and incidental activity, not just planned exercise. It is also clear that minimal research has considered the association of likelihood of depression with settings of physical activity interventions (i.e. home- or centre-based). The null association between physical activity and depression seen in some observational studies (Cooper-Patrick et al., 1987; Bailey and McLaren, 2006) may have been due to the fact that physical activity was reported as a ‘total’ measure of combined work-related, domestic and leisure-time physical activity.

A number of researchers have hypothesized that physical activity reduces risk of depression through physiological pathways — for instance, exercise may activate endorphin secretion, which reduces pain and produces a euphoric sensation (Paluska and Schwenk, 2000). Other hypotheses include the ‘Transcendent Hypofrontality Hypothesis’, which suggests that exercise decreases neural activity in the prefrontal cortex that effects emotion and cognition (Dietrich, 2006); and the ‘Endocannabinoinds Hypothesis’, which suggests that exercise increases serum concentrations of endocannabinoinds, which is turn acts to reduce pain sensation and alter cognitive processes (Dietrich and McDaniel, 2004). However, the present findings that leisure-time physical activity may be more consistently or strongly associated with reduced likelihood of depression than a ‘total’ activity measure suggest some alternative possible explanations, such as a lack of enjoyment or a lack of perceived control or choice when undertaking activities in domains other than leisure-time (i.e. work-related, domestic, and transport-related). The more consistent associations found for leisure-time physical activity could also be explained by the ‘distraction hypothesis’, which proposes that improvements in mental well-being following exercise are due to diverting negative thoughts and unpleasant stimuli during the activity (Greist et al., 1979).

Alternatively, a stronger association between leisure-time physical activity and reduced risk of depression could be explained by the ‘social interaction’ hypothesis, as leisure-time physical activity is often undertaken in a social environment. The ‘social interaction’ hypothesis posits that the improvements in mental health following exercise are at least partly related to the mutual support and social relationships that are provided when participating in physical activity with others (Ransford, 1982). As noted earlier in the discussion, even quite low doses of physical activity may be beneficial to mental health (e.g. 20–60 min/week); therefore, it may be that the context of physical activity (i.e. where, when and with whom) is more important than the absolute amount. However, whilst leisure-time physical activity appears to be beneficial in reducing the likelihood of depression, further evidence on the potential benefits of other physical activity domains is required.

Study limitations

Although previous reviews have concluded that physical activity is associated with better mental health, many studies identified in both previous reviews and the current review were limited by methodological weaknesses. These include small sample sizes (Doyne et al., 1983; Hughes et al., 1986; Sime, 1987; DeForge et al., 1989; Moore et al., 1999; Annesi et al., 2004; Bailey and McLaren, 2005) and short follow-up time in longitudinal studies (Cooper-Patrick et al., 1987; Farmer et al., 1988; Bernaards et al., 2006; Wise et al., 2006). Generally, these studies relied on self-report measures (surveys/questionnaires) of physical activity which possess the potential for error in judgement, recall difficulties and mis-interpretation of questions, and the possibility of socially desirable responses. Observational studies only provide a ‘snapshot’ of associations and cannot provide evidence of causality. For example, those who are more depressed or at risk of depression may be less likely to be interested or motivated to participate in physical activity.

Several studies include measures of mental health, which do not specifically assess depression. For example, the GHQ is used more as a measure of psychopathology (Schmitz et al., 1999), whilst the POMS is more specifically a measure of mood state, with only aspects of depressive symptoms included (Shacham, 1983). Furthermore, several intervention studies did not employ a control condition (Klein et al., 1985; Fremont and Craighead, 1987; Emery and Blumenthal, 1988; Martinson et al., 1989; Dimeo et al., 2001; Annesi et al., 2004; McLaugherty et al., 2004; Mott et al., 2005) and therefore intervention effects were difficult to determine. Several studies that examined physical activity
intensity also assessed physical activity of different durations (Blumenthal et al., 1989; Brown et al., 1995) making it difficult to differentiate the effects of intensity from the effects of duration. A number of studies were also unable to control for variables such as social support due to the fact that participants were required to exercise under supervision or in group situations. This may be problematic as social support is a factor that is strongly associated with better mental health (Nasser and Overholser, 2005).

Conclusion

This review has identified observational and intervention studies showing inverse associations between physical activity and the likelihood of depression in adults. It has provided some insights into the optimal dose (frequency, duration and intensity) of physical activity for reducing the risk of depression in adults. Despite inconsistencies in studies, findings suggest that even relatively low doses of physical activity may have a protective effect against the likelihood of depression. However, this review further emphasizes the fact that few clear conclusions can be made regarding the optimal dose, domain and setting of physical activity for reducing the likelihood of depression, with several major gaps in the research area of physical activity and depression remaining. Further studies, in particular RCT’s, examining the optimal physical activity dose, domain and setting for reducing the likelihood of depression are needed in order to provide appropriate recommendations to the community in an effort to improve mental health through the promotion of physical activity.

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References


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