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Physical activity and health

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Introduction

Participation in physical activity is associated with significant benefits to health, most importantly in the prevention of Type 2 diabetes, cardiovascular disease and some cancers (Bauman et al., 2002; United States Department of Health and Human Services [USDHHS], 1996). In this chapter, we provide an overview of research on health-enhancing physical activity in adults. We provide brief examples of epidemiological studies on the relationships of physical activity to health outcomes; we also consider descriptive studies of adult populations on levels of participation. Our focus is on physical activity as a set of behaviours: we describe research findings on the ‘determinants’ of physical activity and describe the theories of health behaviour that are now widely used in understanding and influencing physical activity.

Physical activity exercise and fitness

The terms, ‘physical activity’, ‘exercise’ and ‘fitness’ are sometimes used interchangeably and at times incorrectly (Salis & Owen, 1999).
'Physical activity' refers to any bodily movement, but generally to the movements of groups of large muscles (particularly of the legs and arms) that result in significant increases in metabolic energy expenditure, above the resting level. Regularly taking part in such activities is associated with better health outcomes. Physical activity can be performed at a wide range of intensities: walking or other moderate-intensity activities such as swimming at a low, moderate or brisk pace; vigorous endurance activities (for example, jogging or running, walking fast uphill, riding a bicycle fast or in hilly terrain); and activities that increase strength and/or flexibility (for example, weight training, calisthenics or strenuous occupational or domestic tasks such as heavy lifting or carrying). 'Exercise' is physical activity done with the explicit purpose of improving or maintaining physical fitness or health. Exercise can be performed at a variety of intensities, although it usually involves more vigorous activities. Nevertheless, walking at a moderate intensity can be exercise, if it is done for the purpose of improving fitness or health.

Physical fitness is a physiological state, not a behaviour. It is thus not interchangeable with the terms 'physical activity' or 'exercise', which refer to sets of behaviours and to their contexts or purposes. Psychological fitness (personal resiliency or 'hardiness') can be associated with physical fitness. While psychological fitness is distinct from physical activity or fitness, for some individuals or groups (for example, athletes or those who are living with a chronic illness), the relationship between these two domains of health and well-being will be strong.

A behavioural epidemiology framework for physical activity and health

Sallis & Owen (1999) propose five main phases of 'behavioural epidemiology' research, as they may be applied to physical activity and health:

1. Establish the links between physical activity and health: This phase is complex, because different types and amounts of physical activity are related to different health benefits and risks. Once epidemiological and other studies document the associations between the relevant behaviour and health outcomes, research in the subsequent phases has strong foundations.

2. Accurately measure physical activity: The measurement of physical activity, particularly in large population studies and in the evaluation of interventions, is an ongoing challenge, but high quality measures are essential for all types of research. Many studies rely on self-report data, but more objective measurement tools are being developed and validated.

3. Identify factors that influence physical activity: Describing the characteristics of those who are most and least active can be helpful in deciding which groups are most in need of interventions. The potentially modifiable factors that are identified can then be targeted for change in exercise counselling, programmes or public campaigns.

4. Develop and evaluate interventions to promote physical activity: The majority of adults in the populations of industrialized nations are not sufficiently physically active for health benefits. Effective, evidence-based intervention programmes need to be developed and tested systematically.

5. Translate research into policy and practice: Each phase of the behavioural epidemiology framework is intended to build upon the previous phase or phases, so that evidence-based approaches may be adopted more widely and with confidence.

Understanding and influencing physical activity for individuals, groups, communities and whole populations is a new and important interdisciplinary area. Health psychology experts in the physical activity field work closely with exercise physiologists, physical educators, epidemiologists and other social and biomedical scientists (Sallis et al., 2000).

Health psychology has much to offer. Psychological theories and methods are used in clinical and community settings to guide health practitioners in assisting individuals to become more physically active. They are used to inform the development of large-scale interventions for communities and populations (Marcus et al., 1998). Psychological theories underpin ecological models of health behaviour (Owen et al., 2004; Sallis & Owen, 1997, 2002). These provide a conceptual basis for the environmental and policy initiatives which will be needed to bring about population-wide increases in physical activity (Sallis et al., 1998).

Phases 3 and 4 of the behavioural epidemiology framework (identifying factors that influence physical activity; developing and evaluating interventions to promote physical activity) are where health psychology has made particularly strong contributions. These have been in the development of conceptual models, in measurement and other research methods and in developing a plethora of practi­cal programmes. These two phases of research and application form the main focus of our chapter.

Physical activity and population health outcomes

There is a substantial body of evidence suggesting that regularly taking part in physical activities of moderate intensity (for example, recreational walking or cycling) can have significant health-protective benefits (Bauman et al., 2002; USDHHS, 1996). In the 1980s and early 1990s, the strongest evidence for physical activity and health benefits was in the area of heart-disease prevention. More recent reviews support the earlier recommendations on physical activity and health and continue to emphasize participation in moderate-intensity activities (particularly walking) on most days of the week for 30 minutes or more: this criterion is intended to be realistic and optimal for achieving health benefits in sedentary adult populations (Bauman, 2004). Higher volumes and intensities of activity and specific types of activity such as strength training have additional health benefits (Bauman et al., 2002; USDHHS, 1996).

Epidemiological studies and controlled trials conducted in recent years reinforce the broader preventive benefits and the range of specific disease outcomes that may be postponed or amended, by being physically active on a regular basis. This is seen clearly in the case of Type 2 diabetes. There is recent compelling evidence from controlled trials that regular physical activity has a key role in the prevention of Type 2 diabetes in high-risk groups. For example, in a study conducted in Finland, intensive nutritional counselling and endurance exercise advice given to people with impaired glucose tolerance resulted in a significantly lower rate of progression to diabetes, compared with a control group.
The decrease in risk was related to the degree of lifestyle change (Tuomilehto et al., 2001) (see 'Diabetes').

Physical activity also contributes to a reduced risk of developing some cancers, particularly colon and breast cancer (International Agency for Research on Cancer [IARC], 2002). There is a reduction in risk of colon cancer with increasing levels of activity, particularly more intense activities. Recent reviews highlight the potential for physical activity to reduce the risk of breast cancer, with indications of a 20–40% risk reduction in both pre- and post-menopausal women (Thune & Furberg, 2001). Physical activity has an independent effect on colon and breast cancer risk in addition to its role in preventing unhealthy weight gain (IARC, 2002).

The increasing population prevalence of inactivity is an important contributor to what is now being characterized as an 'obesity epidemic' (Erichman et al., 2002). Physically active persons are less likely to gain weight over the course of their adult lives. Findings from a range of cross-sectional studies have shown lower weight, body mass index or skin-fold measures among people with higher measured fitness and higher levels of habitual physical activity; however, prospective studies have shown less consistent relationships (Erichman et al., 2002) (see 'Obesity').

Over half of the adult population in most industrialized countries is, however, insufficiently physically active for health benefits (USDHHS, 1996). For example, recent data on trends in physical activity participation in Australia in the late 1990s (Bauman et al., 2002; Bauman et al., 2003) suggest that the rate of participation in physical activity by adults had declined by 6% between 1997 and 1999. Less than 50% of adult Australians achieved the recommended 150 minutes (30 minutes on at least five days of the week) of at least moderate-intensity activity. Similar findings have emerged in population surveys in the UK (Hillsdon et al., 2001).

Public policies and programmes to encourage physical activity are being pursued seriously in many developed countries and elsewhere (Bauman et al., 2002; USDHHS, 1996). Yet, the majority of the adult population of many industrialized countries is not engaging in the level of activity needed to accrue worthwhile health benefits. Thus, there is much that needs to be done, in research and in practice, to increase participation in physical activity. Effective interventions which can change the personal, social and environmental factors related to physical inactivity are needed.

Identifying factors that influence physical activity

The published research on physical activity is replete with findings from cross-sectional investigations of the associations between physical activity and a range of personal, social and environmental factors.

The term ‘determinant’, as it has typically been used in the physical activity research literature, is often used incorrectly to characterize studies (most typically cross-sectional surveys) that demonstrate reproducible associations (‘correlates’), rather than cause-and-effect relationships (Bauman, Sallis et al., 2002). While such correlations do not identify cause-and-effect relationships, they do help to generate hypotheses for further study and can illuminate the relevance (or otherwise) of particular theoretical constructs.

| Table 1. Summary overview of the new evidence from studies of the correlates of physical activity, published since 1998 (based on the review by Trost et al., 2002) |
|-----------------|-----------------|
| Demographic and biological factors | - Marital status (married; -) |
| | - Overweight or obesity (-) |
| Psychological, cognitive and emotional factors | - Self-efficacy for physical activity (+) |
| | - Barriers to physical activity (lack of time; -) |
| Behavioural attributes and skills | - Past physical activity behaviour or 'habit' (+) |
| | - Healthy diet (+) |
| | - Smoking (-) |
| Socio-cultural factors | - Social support (+++) |
| Physical environment factors | - Exercise equipment at home (+) |
| | - Perceived access to facilities (+) |
| | - Satisfaction with recreational facilities (+) |
| | - Neighbourhood safety (+) |
| | - Hilly terrain (+) |
| | - Frequently observe others exercising (+) |
| | - Enjoyable scenery (+) |
| | - Urban location (-) |

- mixed or weak evidence of negative association; --- strong negative association; + mixed or weak evidence of positive association; ++ strong positive association.

Sallis & Owen (1999, Chapter 7) examined the personal, social and environmental factors associated with adults’ participation in physical activity. Six classes of correlates of activity were identified: demographic and biological factors; psychological, cognitive and emotional factors; behavioural attributes and skills; socio-cultural factors; physical environment factors; and physical activity characteristics.

The overall pattern of findings suggests that individual-level attributes such as socioeconomic status and perceived self-efficacy demonstrate the strongest and most consistent associations with physical activity. Fewer consistent positive or negative associations were found in relation to behavioural attributes and personal skills, sociocultural influences and physical environmental influences.

In a more recent review, Trost et al. (2002) reported further evidence on associations between these six classes of attributes and being physically active, engaging in particular activities or conducting higher volumes of activity (see Table 1).

Several of the correlates of physical activity listed in Table 1 are associated with constructs from theoretical models of health behaviour. These correlates, for example, include self-efficacy, perceived barriers, past exercise habits and environmental attributes. The relevant theoretical models from health psychology, as we will illustrate below, have been particularly influential in the development of physical activity interventions.

Theories of physical activity behaviour and their applications

Theoretical models of health behaviour (see Glanz et al., 2002) have been applied to research on the factors which can influence physical
activity and to the development and evaluation of interventions (see Godin, 1994; Marcus et al., 1998; Owen et al., 2004; Sallis & Owen, 1997, 2002; Spence & Lee, 2003).

Social–cognitive theory

Social–Cognitive Theory (SCT) has been widely used in developing interventions to influence physical activity, often in combination with constructs such as stages of change and the Transtheoretical Model (TTM; Marcus, Owen et al., 1998). SCT has been particularly helpful in expanding the understanding of factors that influence physical activity participation, beyond individual-level factors. Theories focusing more on intra-personal processes (for example, attitudes, intention, beliefs) such as the Theory of Planned Behaviour and the Theory of Reasoned Action, have been applied to understanding the determinants of physical activity behaviour, with modest but, in many cases, significant predictive power (Godin, 1994).

Social–cognitive Theory proposes that personal, behavioural and environmental factors operate as reciprocal interacting determinants (Bandura, 1986). Studies of the correlates of physical activity and intervention trials based on SCT have focused on the individual’s ability to control her or his own behaviour (or ‘self-efficacy’) and on how changes in the individual, the environment, or in both can produce changes in behaviour.

Bandura (1986) identifies four main sources of influences on self-efficacy: mastery of accomplishments (learning new skills and building confidence through successful new experiences); social modelling (learning new skills by observing others); social persuasion (being convinced by others of the desirability of new activities and their outcomes); and the interpretation of physiological states (in the case of physical activity, this might include, for example, interpreting the physical signs of exertion generally, or learning to feel comfortable with increased heart rate and respiration changes) (see ‘Self-efficacy and health’).

The transtheoretical model

The TTM (also know as the ‘Stages of Change’ model; Prochaska & DiClemente, 1983) has formed the theoretical basis for a number of cross-sectional studies and intervention trials on physical activity. According to the TTM, five stages of motivational readiness for physical activity may be identified (Marcus & Simpkin, 1994).

In the initial stage (precontemplation), individuals do not intend to take action to become more physically active in the foreseeable future. However, as the individual becomes more aware of the costs and benefits of engaging more regularly in physical activity, he/she progresses to the second stage (contemplation). As the individual takes steps to engage in physical activity (preparation), the development of behavioural plans and skills may assist him/her to become active. The fourth stage (action) occurs when an individual starts to become active, and the fifth stage (maintenance) is when the individual is able to continue activity on a regular basis for six months and beyond. Both the fourth and the fifth stages of behavioural change often require individuals to employ both cognitive and behavioural strategies to assist in avoiding relapse (dropping out of regular physical activity), or in re-engaging in activity following relapse (see ‘Transtheoretical model of behaviour change’).

Interventions derived from SCT and the TTM

Interventions targeting self-efficacy and decision-making (key constructs from SCT and the TTM) have accumulated significant support from research trials (Sallis & Owen, 1999). These interventions emphasize building confidence about being physically active (enhancing self-efficacy). They also use specific techniques such as goal setting, completing ‘decisional balance’ protocols (explicitly listing and considering both the advantages and disadvantages of trying to be more active), relapse prevention training (skills in resuming being more active after time out), stimulus control (how to identify environmental factors that can prompt and remind one to be more active) and social support (help and encouragement from others).

Methods based on such behavioural techniques have a long history of being used in combined ways in physical activity interventions. For example, Martin et al. (1984) conducted a series of cognitive–behavioural intervention trials with sedentary adults. They found that attendance at exercise sessions was significantly improved by frequent personalised praise and feedback from instructors, and flexible goal setting. Overall, the interventions based on SCT produced attendance rates of 80% or greater, while a control group with the most basic programme had attendance of around 50%. In another intervention study, McAuley et al. (1993) randomly assigned middle-aged, sedentary adults to a self-efficacy enhancing programme or to a standard walking programme. Following the intervention, those in the efficacy-enhancement group were walking almost 50% more than were those in the control group. These two examples provide an example of how specific and combined SCT-based components can contribute to at least short-term successes of physical activity interventions which are delivered face-to-face in structured settings.

Other evidence however, suggests that most people prefer to be active on their own – either at home or in their local neighbourhood (Booth et al., 1997). This is in contrast to using structured facilities such as gyms or fitness centres. Attending a clinic, a fitness facility or leisure centre, a class or group is inconvenient for many people: it may be more difficult for some to actually get to the site of the class than it is to engage in the physical activity elsewhere. There is a modest but consistent body of research to suggest that mass media campaigns targeting those in early stages of motivational readiness for physical activity can result in significant increases in slogan and message content recall, and have significant, but small and short-term impacts on behaviour (Bauman et al., 2001; Marcus et al., 1998).

Trials of ‘mediated’ interventions based on the TTM have used print and Internet delivery methods (Bock et al., 2001; Marcus et al., 1998). These interventions aim to match the main elements of the programme to the individual’s stage of motivational readiness for change. However, the task of matching interventions to a person’s level of motivational readiness for change must take into account that some people are not yet ready to change their behaviour but may be ready to make changes in their thinking about behaviour (Marcus & Forsyth, 2003). For example, programmes for precontemplators may focus on enhancing particular: aspects of knowledge;
programmes for those in the action stage may, for example, focus on social support and injury prevention.

There is promising new evidence for the potential of physical activity programs that can be delivered via telephone and the Internet (Napolitano et al., 2003). However, the trials of Internet-delivered programmes thus far have dealt with small numbers of self-selected participants. A recent Australian trial compared print versus Internet delivery of a stage-targeted programme (Marshall et al., 2003). It identified major challenges in the recruitment and retention of participants. For website-delivered programmes, there remains limited evidence to support their efficacy in changing behaviour, except in trials with small numbers of motivated participants.

While the new mediated approaches do show considerable promise, it is not realistically possible to engage all sedentary or insufficiently active adults in structured, formal physical activity programmes (whether face-to-face or mediated). It may also be unreasonable to expect large proportions of the population to make motivationally driven personal behaviour changes, if these efforts are not fully supported by the relevant environmental circumstances (see also 'Physical activity interventions').

Understanding environmental influences on physical activity: ecological models of health behaviour

Sallis & Hovell (1990) proposed a model of physical activity behaviour based on Social Learning Theory (an earlier version of SCT), which used a combination of personal, cognitive, social and environmental factors to explain patterns of physical activity. A key element of the Sallis and Hovell (1990) model was its emphasis on the role of environmental settings and supports. Specifically, environments that lack resources, or impose barriers may act to reduce the probability that the choice to be active will be made. As we will illustrate below, Sallis and Hovell’s focus on the role of the physical environment has been developed within ‘ecological’ models of physical activity behaviour.

Sallis & Owen (1997, 1999, 2002) and Spence & Lee (2003) have proposed an ecological approach to understanding the determinants of physical activity behaviour, and have highlighted the distinction between social and physical environmental influences. Within the physical environment, natural environment factors such as the weather or climate; and built environment factors, such as urban design or availability of facilities can influence physical activity behaviour (Saelens et al., 2003).

Ecological models can provide frameworks for considering the multiple levels (personal, social, environmental) on which physical activity determinants exert their influences (Sallis & Owen, 1997, 2002; Spence & Lee, 2003). The explicit emphasis on attributes of the physical environment in a complex, multi-level network of causality is a key feature of ecological models of physical activity (Owen et al., 2000; Sallis & Owen, 1997, 2002). In public health advocacy and community initiatives, Sallis and Owen’s (1997, 2002) ecological model has been used to highlight the interactions of social and organizational factors with environmental attributes and the communication media initiatives that can prompt personal choices to be active (Matsudo et al., 2004).

The ‘behaviour settings’ construct, drawn from ecological psychology (Barker, 1968) is a key to understanding the role of environmental determinants of physical activity (Owen et al., 2000). Behaviour settings are the physical and social contexts in which behaviours occur, some being supportive of activity and others being discouraging or prohibiting of activity (Wicker, 1979).

Because cognitive–social theories (particularly SCT and the TTM) have been the predominant influences in behavioural studies of physical activity (Godin, 1994), the field has been shaped by assumptions that choices to be active or inactive are conscious, deliberate choices – consequent upon attitudes, intentions, self-efficacy and other cognitive mediators of behavioural change (Owen et al., 2004). However, social-cognitive models do identify a strong role for environmental influences under some circumstances. For example, Bandura (1986) has argued that when behaviour is strongly facilitated or constrained by attributes of the environment in which it takes place (and plausibly this is often likely to be so for physical activity), direct environmental influences would be the predominant class of determinants.

Differences in physical activity between communities that have different environmental attributes have been observed – residents of ‘traditional’ communities, characterized by higher population density, higher street connectivity and mixed land use (‘high walkable’), report significantly more walking and cycling for transport, than do residents of low population density, poorly-connected and single land use (‘low walkable’) neighbourhoods (Saelens et al., 2003). Overall, there was an average difference between high- and low-walkable communities of approximately 15–30 minutes more walking per week for residents of high-walkable neighbourhoods.

The evidence from behavioural and public health research has recently been reviewed (Humpel et al., 2002; Owen et al., 2004) and a number of environmental attributes associated with being physically active have been identified (see Table 1). Even if relatively small amounts of the variation in physical activity are ultimately explained by the influence of environmental variables, it is the case that whole communities can be impacted by any change to make the environment more supportive of physical activity (Giles-Corti & Donovan, 2002). The effects of many small effects across communities could accumulate, to result in substantial support for individual behaviour change, which should lead to broader changes across whole populations.

Conclusions

Health psychology research and interventions to influence physical activity are rapidly developing areas, stimulated by a strong and growing body of evidence on the major health benefits of being habitually active. Health psychologists have contributed significantly to the knowledge base and to developing, refining and applying the theories that are now widely used in the physical activity field. We have used a behavioural epidemiology framework to highlight those dimensions of research on physical activity and health (understanding determinants, developing theoretical models, designing interventions), within which health psychology has particularly important contributions to make.

It seems likely that future conceptual and practical advances will come from the blending together of the best of what is known about motivational approaches, with an ecological perspective.
Our understanding of the relevant determinants will become more definitive and theories of physical activity behaviour will be refined. It thus should be possible to design and implement interventions that will strongly mobilize the personal, social and environmental factors which can help people to initiate and maintain the relevant behavioural changes.

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