Opportunities to promote healthy maternal weight during and following pregnancy

by

Paige van der Pligt

BNutrDiet(Hons)
BAppSc(FoodSc&Nutr)

Submitted in fulfilment of the requirements for the degree of

Doctor of Philosophy

Deakin University
September, 2015
I am the author of the thesis entitled

Opportunities to promote healthy maternal weight during and following pregnancy

submitted for the degree of Doctor of Philosophy

This thesis may be made available for consultation, loan and limited copying in accordance with the Copyright Act 1968.

'I certify that I am the student named below and that the information provided in the form is correct'

Paige Felicity van der Pligt

(Please Print)

Signed: .................................................................

Date: .................................................................

September 3rd, 2015
DEAKIN UNIVERSITY
CANDIDATE DECLARATION

I certify the following about the thesis entitled (10 word maximum)
Opportunities to promote healthy maternal weight during and following pregnancy

submitted for the degree of Doctor of Philosophy

a. I am the creator of all or part of the whole work(s) (including content and layout) and that where reference is made to the work of others, due acknowledgment is given.

b. The work(s) are not in any way a violation or infringement of any copyright, trademark, patent, or other rights whatsoever of any person.

c. That if the work(s) have been commissioned, sponsored or supported by any organisation, I have fulfilled all of the obligations required by such contract or agreement.

I also certify that any material in the thesis which has been accepted for a degree or diploma by any university or institution is identified in the text.

'I certify that I am the student named below and that the information provided in the form is correct'

Paige Felicity van der Pligt
(Please Print)

Signed: 

Signature Redacted by Library

Date: May 5th, 2015

Deakin University CRICOS Provider Code 00113B
Acknowledgements

My sincere thanks go to so many people who have assisted me with my thesis and contributed to the wonderful memories I have of the past four years. Thank you to the following five people who have been my supervisors throughout my PhD. Firstly, to my primary supervisor Karen Campbell. I would never have started the PhD journey if it weren’t for your encouragement and your trust in my ability. Thank you for giving me focus and purpose during a time when I most needed it. I truly value the support you gave me through my personal struggles along with your generosity in allowing me to spend days and nights writing at ‘Laurel Bank’ when I first started my PhD. I will forever be thankful for your support throughout my PhD and for your friendship along the way.

Kylie Ball, thank you for your constant professional and personal guidance. I feel lucky to have been able to share my PhD work with you and have always valued your expertise and your input. You’ve been a great support to me over the past four years and made the difficult times seem just fine. I’ve enjoyed our chats about anything and everything and will always look back with such fondness reflecting on the stories we’ve exchanged over coffee and lunch and the many laughs we’ve had.

David Crawford, thank you for the endless support you’ve given me over the past four years. In many ways you’ve guided me in the ‘right’ direction and helped make the PhD experience a lot easier than it could have been for me. Thank you for helping me gain the confidence I needed and for your encouragement to achieve my goals. I will always be grateful for the times you made sure I was ‘doing ok’.

Kylie Hesketh, thank you for your constant support and for never seeming like anything was ‘too much trouble’. Thank you for always making the time to talk about my work, even when it was a quick chat on the stairs! I will always appreciate the career advice and guidance you’ve given me and will be eternally grateful for having you as such a wonderful career role model.

Megan Teychenne, I’m so thankful to have had you as a supervisor these past few years. You’ve been so supportive, always opened your door to me and been so generous with your time. Thank you for the walking meetings, the late afternoon chocolate runs and the endless
laughs and entertainment along the way. I’m looking forward to future collaborations and most of all, to a newfound friendship.

In addition, Gavin Abbott, thank you for your statistical advice and expertise. I will always appreciate your assistance with my analyses of both studies two and three of my thesis. Thank you for your patience and your willingness to help me out at times when I was clearly confused and stressed.

Shelley Wilkinson, thank you for your guidance and for being a mentor to me over the last couple of years. I feel so lucky to have met you through the PhD process and feel blessed to now consider you a friend. I look forward to continuing to share our interest in pregnancy research. Thank you for the phone chats and laughs on a Saturday night, for ‘checking in’ to make sure I hadn’t ‘disappeared down the rabbit hole’, and for always sharing your knowledge, advice and humour.

Thank you to the National Health and Medical Research Council for funding my research through a postgraduate scholarship. Their generous financial support has contributed to allowing me multiple opportunities to disseminate my research at both national and international conferences and to build international collaborations; experiences for which I am extremely grateful.

Thank you to my treasured friends and my family for supporting me on this journey. For the laughs, the distraction, for continuously ‘checking up on me’ and for understanding when on most occasions my PhD had to come first. I am so blessed to have all of you in my life.

In particular, thank you to my aunty Barbara, I will forever be grateful for your generosiy and support in allowing me to live at ‘Leslie St’ these past three years. The fond memories of staying up late working on my thesis and of arriving home late at night from the office to a lovely flat I was able to call home, will always be cherished. My appreciation is endless and I cannot thank you enough.

To my best friend Camille. Thank you for taking the time to proof read my thesis and for the enormous encouragement you’ve continuously given me since I started my PhD. Our phone conversations about anything and everything, runs around Princes Park, our catch up dinners
and the endless hours spent laughing until our stomachs hurt, are always the best times. Every day I’m thankful for our friendship.

To my dear friend Jane Willcox. I feel so lucky to have crossed ‘PhD paths’ with you, to have shared the PhD journey with you and to have gained what I know to be a lifelong friendship with you. You have been such an amazing support to me and I will forever be grateful. Thankyou for the laughter amidst the chaos and thank you for the memories!

Lastly, to my beautiful grandma Lorna who passed away during my PhD. She told me before she left this earth that “good things” would happen to me. I can honestly say that this is one of the best. I wish you were here today ‘Nornie’. If you were, I’m sure you would be insisting I have a glass of sherry with you.

~

“Begin at the beginning”, the King said, very gravely, “and go on till you come to the end: then stop”.

Lewis Carroll, Alice in Wonderland.
# Table of Contents

List of Abbreviations ................................................................................................................ 5  
List of Tables ............................................................................................................................. 6  
List of Figures ............................................................................................................................ 8  
List of Appendices ..................................................................................................................... 9  
Abstract ...................................................................................................................................... 10  
Chapter 1  
Introduction ............................................................................................................................... 13  
Chapter 2  
Literature review ......................................................................................................................... 16  
2.1 Introduction .......................................................................................................................... 16  
Part 1: Background ..................................................................................................................... 17  
2.2 Overweight and obesity among adult women ..................................................................... 17  
2.2.1 Obesity prevalence, trends and implications for health ................................................. 17  
2.2.2 Overweight and obesity is more prevalent in women than men ...................................... 19  
2.2.3 Women of childbearing age are most at risk of overweight and obesity ............................. 20  
2.2.4 Overweight and obesity in women are associated with many adverse health outcomes ................................................................................................................................. 20  
2.3 The financial burden of overweight and obesity .................................................................. 21  
2.3.1 Health costs and the public health burden of overweight and obesity ............................. 21  
2.3.2 Health costs and public health burden of pregnancy related overweight and obesity ......... 22  
2.4 Excess gestational weight gain defined ............................................................................... 23  
2.4.1 Components of gestational weight gain ......................................................................... 23  
2.4.2 Gestational weight gain recommendations ....................................................................... 24  
2.4.3 Excess gestational weight gain is common and increasing ............................................... 25  
2.5 Maternal overweight and obesity and excess gestational weight gain are associated with multiple adverse health outcomes for the mother and child ................................................................. 26  
2.5.1 Health complications of maternal overweight and obesity for the mother and child .......... 27  
2.5.2 Health complications of excess gestational weight gain for the mother and child ............... 29  
2.5.3 Maternal overweight and obesity and excess gestational weight gain are associated with childhood obesity .................................................................................................................... 30  
2.6 Excess gestational weight gain is linked to postpartum weight retention and subsequent adverse health implications ................................................................. 31  
2.6.1 Excess gestational weight gain predicts postpartum weight retention ............................... 31  
2.6.2 Postpartum weight retention is variable ........................................................................... 33  
2.6.3 Postpartum weight retention is associated with adverse health implications for subsequent pregnancies ................................................................................................................... 35  
2.6.4 High postpartum weight retention is linked to long term adverse health implications ......... 36
2.7 Women’s lifestyle behaviours contribute to overweight and obesity during pregnancy and following childbirth

2.7.1 Lifestyle behaviours contribute to excess gestational weight gain

2.7.2 Lifestyle behaviours contribute to overweight and obesity during the postpartum period

Part 2: Management

2.8 Clinical management of maternal weight during pregnancy and the postpartum period

2.8.1 Management of gestational weight gain and barriers to provision of support

2.8.2 Management of maternal postpartum weight and barriers to provision of support

2.9 Summary of lifestyle interventions aimed at limiting excess gestational weight gain and postpartum weight retention

2.9.1 Interventions aimed at limiting excess gestational weight gain

2.9.2 Interventions aimed at limiting postpartum weight retention

2.10 Using technology to drive healthy lifestyle and weight-loss interventions

2.10.1 Web-based health interventions to change behaviour

2.10.2 Interventions utilising technology during the postpartum period

2.11 Conclusion and thesis aims

Chapter 3

Opportunities for primary and secondary prevention of excess gestational weight gain: Views of general practitioners regarding gestational weight gain assessment and management

3.1 Introduction

3.2 Aims

3.3 Methods

3.3.1 Recruitment and data collection

3.3.2 Data analysis

3.4 Results

3.4.1 Participants

3.4.2 Themes

3.5 Discussion

3.6 Strengths & limitations

3.7 Conclusion & implications

Chapter 4

Weight and healthy lifestyle advice across the perinatal period: What advice do women receive and how does advice predict weight, diet, physical activity and sedentary behaviours?

4.1 Introduction

4.1.1 Assessment of weight, diet and physical activity during pregnancy

4.1.2 Assessment of weight, diet and physical activity during the postpartum period

4.2 Aims

4.3 Methods

4.3.1 Recruitment
4.3.2 Data collection .......................................................... 90
4.3.3 Measures ............................................................... 91
4.3.4 Data management and statistical analyses ................. 97
4.4 Results ........................................................................ 98
4.4.1 Participants ............................................................ 98
4.4.2 Maternal weight, diet and physical activity behaviours .. 101
4.4.3 Clinician advice and associations with maternal health outcomes .................................................. 105
4.5 Discussion .................................................................. 109
4.6 Strengths & limitations .................................................. 115
4.7 Conclusion & implications ............................................ 116

Chapter 5

The mums OnLiNE (Online, Lifestyle, Nutrition & Exercise) pilot intervention study: Methodology and results .......................................................... 117
5.1 Introduction .................................................................. 117
5.2 Aims & hypothesis ....................................................... 118
5.3 Methods ....................................................................... 119
5.3.1 Participants ............................................................ 119
5.3.2 Eligibility ................................................................. 122
5.3.3 Matched control groups ........................................... 124
5.3.4 Recruitment process ................................................ 127
5.4 Intervention ................................................................. 131
5.4.1 Intervention overview ............................................. 131
5.4.2 Intervention content ................................................ 133
5.5 Data collection processes ............................................ 137
5.6 Participant retention strategies ..................................... 137
5.7 Measures ..................................................................... 138
5.7.1 Primary outcomes ................................................... 139
5.7.2 Secondary outcomes ................................................ 141
5.7.3 Data management and statistical analyses ............... 146
5.7.4 Confounding factors ................................................ 147
5.7.5 Data inclusion and exclusion ................................... 148
5.8 Results ........................................................................ 150
5.8.1 Participants ............................................................ 150
5.8.2 Anthropometry ......................................................... 153
5.8.3 Dietary intake .......................................................... 155
5.8.4 Physical activity ....................................................... 158
5.8.5 Sedentary behaviour ................................................ 158
5.8.6 Diet and physical activity self-efficacy ....................... 160
5.9 Discussion ................................................................... 162
5.10 Strengths & limitations ............................................... 169
5.11 Conclusion & implications ......................................... 171

Chapter 6

Qualitative evaluation of a postpartum intervention: Views of first time mothers who participated in the mums OnLiNE study .................................................. 173
6.1 Introduction .................................................................. 173
6.2 Aims ............................................................................ 175
6.3 Methods ....................................................................... 175
6.3.1 Recruitment and data collection .............................. 175
6.3.2 Data analysis .......................................................... 178
6.4 Results ........................................................................................................... 178
6.4.1 Participants .............................................................................................. 178
6.4.2 Themes ..................................................................................................... 179
6.5 Discussion ................................................................................................... 193
6.6 Strengths & limitations ............................................................................. 198
6.7 Conclusion & implications ......................................................................... 199

Chapter 7
Summary and conclusions ............................................................................... 200
7.1 Overview of findings .................................................................................. 200
7.2 Implications & future directions ................................................................. 201
7.2.1 Clinical management ............................................................................. 202
7.2.2 Interventions and supportive lifestyle programs .................................... 204
7.2.3 Other areas for further investigation ..................................................... 207
7.3 Strengths & limitations ............................................................................. 208
7.4 Conclusion .................................................................................................. 209

References ....................................................................................................... 211
Appendices ........................................................................................................ A1
Appendix 1: Publication: Systematic review of lifestyle interventions to limit postpartum weight retention: implications for future opportunities to prevent maternal overweight and obesity following childbirth .......................................................... A2
Appendix 2: Publication: Opportunities for primary and secondary prevention of excess gestational weight gain: General Practitioners’ perspectives ........................................................................................................ A17
Appendix 3: InFANT Extend Trial Main Carer Survey (Baseline) ..................... A27
Appendix 4: The Cancer Council of Victoria (CCV) Dietary Questionnaire for Epidemiological Studies (DQES) Food Frequency Questionnaire ........................................................................................................ A48
Appendix 5: Written material included at baseline as part of the mums OnLiNE pilot intervention study .......................................................... A61
Appendix 6: mums OnLiNE intervention Modified Food Frequency Questionnaire (Baseline) ................................................................................................. A89
Appendix 7: mums OnLiNE intervention Diet and physical activity self-efficacy questions ......................................................................................... A106
## List of abbreviations

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>InFANT</td>
<td>Infant Feeding, Activity and Nutrition Trial</td>
</tr>
<tr>
<td>mums OnLiNE</td>
<td>mums Online, Lifestyle, Nutrition and Exercise (study)</td>
</tr>
<tr>
<td>BMI</td>
<td>Body mass index</td>
</tr>
<tr>
<td>WHO</td>
<td>World Health Organisation</td>
</tr>
<tr>
<td>T2DM</td>
<td>Type two diabetes mellitus</td>
</tr>
<tr>
<td>WC</td>
<td>Waist circumference</td>
</tr>
<tr>
<td>ALSWH</td>
<td>Australian Longitudinal Study on Women’s Health</td>
</tr>
<tr>
<td>CVD</td>
<td>Cardiovascular disease</td>
</tr>
<tr>
<td>CHD</td>
<td>Coronary heart disease</td>
</tr>
<tr>
<td>GWG</td>
<td>Gestational weight gain</td>
</tr>
<tr>
<td>IOM</td>
<td>Institute of Medicine</td>
</tr>
<tr>
<td>PPWR</td>
<td>Postpartum weight retention</td>
</tr>
<tr>
<td>GDM</td>
<td>Gestational diabetes mellitus</td>
</tr>
<tr>
<td>APGAR</td>
<td>Appearance, Pulse, Grimace, Activity, Respiration</td>
</tr>
<tr>
<td>LGA</td>
<td>Large for gestational age</td>
</tr>
<tr>
<td>SGA</td>
<td>Small for gestational age</td>
</tr>
<tr>
<td>SPAWN</td>
<td>Stockholm Pregnancy and Women’s Nutrition</td>
</tr>
<tr>
<td>PA</td>
<td>Physical activity</td>
</tr>
<tr>
<td>LTPA</td>
<td>Leisure time physical activity</td>
</tr>
<tr>
<td>GP</td>
<td>General practitioner</td>
</tr>
<tr>
<td>EPC</td>
<td>Enhanced Primary Care</td>
</tr>
<tr>
<td>RCT</td>
<td>Randomised controlled trial</td>
</tr>
<tr>
<td>SEP</td>
<td>Socio-economic position</td>
</tr>
<tr>
<td>SEIFA</td>
<td>Socio-Economic Indices for Areas</td>
</tr>
<tr>
<td>CCV</td>
<td>Cancer Council of Victoria</td>
</tr>
<tr>
<td>DQES</td>
<td>Dietary Questionnaire for Epidemiological Studies</td>
</tr>
<tr>
<td>FFQ</td>
<td>Food Frequency Questionnaire</td>
</tr>
<tr>
<td>DEF</td>
<td>Daily equivalent frequency</td>
</tr>
<tr>
<td>AAS</td>
<td>Active Australia Survey</td>
</tr>
<tr>
<td>(I)</td>
<td>Intervention group (mums OnLiNE)</td>
</tr>
<tr>
<td>(C1)</td>
<td>Control group 1 (mums OnLiNE)</td>
</tr>
<tr>
<td>(C2)</td>
<td>Control group 2 (mums OnLiNE)</td>
</tr>
</tbody>
</table>
**List of Tables**

**Table 2.1** The WHO BMI cut-points for classification for overweight and obesity

**Table 2.2** Australian waist circumference recommendations for increased chronic disease risk in Caucasian men and Caucasian and Asian women

**Table 2.3** Composition of maternal weight gain during pregnancy and contribution to total weight gain

**Table 2.4** The IOM 2009 guidelines for gestational weight gain

**Table 3.1** Interview questions

**Table 3.2** Summary of themes with supporting verbatim quotes

**Table 4.1** Maternal characteristics

**Table 4.2** Maternal weight change from pre-pregnancy to three months postpartum

**Table 4.3** Gestational weight gain and odds of exceeding IOM recommendations by pre-pregnancy BMI category

**Table 4.4** Maternal dietary intake across the perinatal period

**Table 4.5** Postpartum physical activity patterns and sedentary behaviours

**Table 4.6** Associations of clinician advice received with maternal weight, diet, physical activity and sedentary behaviours across the perinatal period

**Table 5.1** Maternal characteristics at baseline

**Table 5.2** Anthropometric outcomes and comparison of anthropometry between the intervention and control groups
<table>
<thead>
<tr>
<th>Table 5.3</th>
<th>Fruit and vegetable intake and comparison between the intervention and control groups from baseline to follow up</th>
</tr>
</thead>
<tbody>
<tr>
<td>Table 5.4</td>
<td>Non-core food intake and comparison between the intervention and control groups from baseline to follow up</td>
</tr>
<tr>
<td>Table 5.5</td>
<td>Physical activity and sedentary behaviour patterns and comparison between the intervention and control groups from baseline to follow up</td>
</tr>
<tr>
<td>Table 5.6</td>
<td>Diet and physical activity self-efficacy and comparison between the intervention and control groups from baseline to follow up</td>
</tr>
<tr>
<td>Table 6.1</td>
<td>Interview questions</td>
</tr>
<tr>
<td>Table 6.2</td>
<td>Summary of verbatim quotes related to the six broad themes</td>
</tr>
</tbody>
</table>
List of Figures

**Figure 5.1**  Women enrolled in the InFANT Extend RCT from which the mums OnLiNE study participants were drawn

**Figure 5.2**  Overview of the eligibility and recruitment to the mums OnLiNE pilot intervention study

**Figure 5.3**  Overview sampling steps for the two control groups in the mums OnLiNE intervention

**Figure 5.4**  Overview of the recruitment strategies employed for the mums OnLiNE pilot intervention study

**Figure 5.5**  Timeline of intervention components and delivery during the mums OnLiNE pilot intervention study

**Figure 5.6**  Overview of data collection employed in the mums OnLiNE pilot intervention study

**Figure 5.7**  Overview of data inclusion for maternal outcomes in the mums OnLiNE study for the intervention group and two control groups

**Figure 5.8**  Overview of women completing the mums OnLiNE intervention
List of Appendices

Appendix 1  Publication: Systematic review of lifestyle interventions to limit postpartum weight retention: implications for future opportunities to prevent maternal overweight and obesity following childbirth

Appendix 2  Publication: Opportunities for primary and secondary prevention of excess gestational weight gain: General Practitioners’ perspectives

Appendix 3  InFANT Extend Trial Main Carer Survey (Baseline)

Appendix 4  The Cancer Council of Victoria (CCV) Dietary Questionnaire for Epidemiological Studies (DQES) Food Frequency Questionnaire

Appendix 5  Written material included at baseline as part of the mums OnLiNE pilot intervention study

Appendix 6  mums OnLiNE intervention Modified Food Frequency Questionnaire (Baseline)

Appendix 7  mums OnLiNE intervention Diet and physical activity self-efficacy questions
Abstract

Understanding the current and future opportunities to promote healthy maternal weight during pregnancy and following childbirth is a key public health consideration. Prevalence of overweight and obesity is higher in women compared to men and higher in women of childbearing age, compared to their older counterparts. Almost half of all women of childbearing age are classified as either overweight or obese, and a similar proportion of women experience excess gestational weight gain, leading to a higher risk of postpartum weight retention.

Maternal overweight and obesity, excess gestational weight gain and postpartum weight retention are associated with multiple adverse maternal and child health outcomes. Yet despite this, a definite gap exists in the promotion of healthy weight attainment during pregnancy and following childbirth. Given the importance of ensuring women are well supported to achieve healthy weight across the perinatal period as well as healthy lifestyle behaviours, it is necessary to gain further insight into where such support might be best delivered.

This thesis describes the methodology and results of four unique studies. The first study was a qualitative study conducted with general practitioners involved in the delivery of antenatal care. The views of general practitioners regarding gestational weight gain management and provision of advice during pregnancy were documented. As women have frequent contact with healthcare providers during pregnancy, clinician management and promotion of healthy maternal weight presents as a promising opportunity for provision of support. However, results indicated that approaches to gestational weight gain management were inconsistent. General practitioners seldom provided recommendations for weight gain during pregnancy and weighed women infrequently throughout pregnancy. Multiple barriers to provision of support were reported by general practitioners with time constraints and a lack of knowledge regarding the appropriate weight to recommend being the most common barriers.

The second study assessed cross sectional survey data and described patterns of maternal weight gain during pregnancy and up to three months postpartum, maternal diet and physical activity patterns and sedentary behaviours. The study assessed the frequency of advice received by first time mothers relating to weight, diet and physical activity, given by healthcare
providers. Associations of the advice received with the relevant maternal weight and healthy behaviour outcomes were reported. The analysis provided understanding regarding the provision of management surrounding healthy weight attainment, across a variety of healthcare providers.

Results showed inconsistencies in approaches to management of maternal weight across the perinatal period. Despite an increase in mean maternal BMI from pre-pregnancy to the postpartum and increased maternal obesity rates, a high proportion of first time mothers reported receiving no advice from their healthcare providers regarding healthy gestational weight gain and an even higher proportion of women received no weight related advice by three months postpartum. The study also found that fewer women reported receiving diet or physical activity advice during the postpartum period than during pregnancy. Overall, when advice was provided to women, it did not promote healthy weight attainment or healthy lifestyle behaviours.

The third study described the methodology and outcomes of a postpartum pilot intervention with first time mothers; the mums OnLiNE study. To date, there have been fewer interventions focussed on reducing postpartum weight retention and improving healthy lifestyle behaviours compared to those which have targeted limiting excess gestational weight gain. Of the interventions that have been conducted during the postpartum period, those that have included both diet and physical activity as part of the intervention components, rather than just one of these, have been more successful in promoting healthy maternal weight.

Maternal anthropometry, including postpartum weight retention and waist circumference measures, as well as diet, physical activity and sedentary behaviours were assessed. Intervention group data was compared with data from two, matched control groups. The mums OnLiNE intervention significantly improved postpartum weight retention and waist circumference measurements. There was no significant difference in maternal diet, physical activity or sedentary behaviour outcomes between the intervention and control groups.

Finally, a qualitative study was conducted with a sub-sample of those women who completed the mums OnLiNE pilot intervention. To date, the views of first time mothers regarding best supportive strategies to target weight, diet and physical activity following childbirth have rarely been described. Moreover, qualitative evaluation of a postpartum intervention was a novel
approach to gaining insight into suitability and acceptance of a lifestyle program aimed at supporting new mothers in their attainment of healthy postpartum weight. Results showed that new mothers held positive views and valued the support they received by taking part in the mums OnLiNE intervention. Many women reported increased awareness for healthy lifestyle behaviours as a result of participation in the mums OnLiNE program. Lack of time was a significant barrier to engagement in the program and women faced difficulty prioritising their own health due to demands in caring for their newborn.

Overall, the results of this thesis showed that inconsistencies in the management of maternal weight and promotion of healthy lifestyle behaviours exist. Many barriers to the provision of adequate support for women in attaining a healthy weight, both during pregnancy and following childbirth have been identified. With healthcare provider advice being shown not to predict healthy maternal weight or lifestyle behaviours, more rigorous approaches to targeting maternal weight, such as lifestyle interventions, are likely to be more successful than provision of advice alone.

Postpartum intervention such as the mums OnLiNE intervention have capacity to assist women in reducing postpartum weight retention and waist circumference. Whilst new mothers face difficulty prioritising their own health during the postpartum period due to competing demands of caring for their child, weight-focussed programs including group support and one-on-one counselling are recommended by first time mothers. Future work aimed at promoting healthy maternal weight and healthy lifestyle behaviours across the perinatal period is needed, to assist reducing risk of adverse maternal and child health outcomes, obesity and related morbidity.
Chapter 1

Introduction

Understanding opportunities to support women in achieving a healthy weight during pregnancy and following childbirth is an important public health consideration. Approximately half of all women of childbearing age are classified as either overweight or obese, and a similar proportion of women experience excess weight gain during pregnancy, leading to a higher risk of weight retention following childbirth. Maternal overweight and obesity and excess weight gain during pregnancy are associated with many well documented health consequences for both the mother and child. Furthermore, increased weight during this life stage increases the risk for overweight and obesity in the long term.

Despite the high prevalence of adiposity in this group and its impost on health, optimal strategies to support women in their attainment of healthy weight across the perinatal period remain unclear. Women have frequent contact with healthcare providers during this life stage and as such, clinician management and promotion of healthy maternal weight presents as a promising opportunity for provision of support. Despite this prospect, the extent to which women receive weight related advice across the perinatal period has rarely been investigated. Similarly, the engagement of healthcare providers and the influence of their advice on women’s lifestyle behaviours is poorly described.

Pregnant women and new mothers are a population vulnerable to weight gain. Therefore, lifestyle interventions targeting maternal weight through promoting healthy diet and physical activity behaviours are important for promoting optimal health outcomes. However, the efficacy of interventions that focus on limiting excess gestational weight gain and postpartum weight retention are largely inconclusive; the appropriate time to intervene is unclear and consistently effective approaches remain to be determined. Whilst studies focussing on promoting healthy gestational weight gain are emerging in the literature, few have targeted limiting postpartum weight retention. Given the importance of ensuring women are well supported to achieve a healthy weight across the perinatal period, it is necessary to gain further insight into when and how such support might be best delivered. Hence this thesis aims to identify opportunities to support healthy maternal weight during pregnancy and following childbirth.
Chapter 2 of this thesis provides an overview of the literature regarding patterns of gestational weight gain and postpartum weight retention as well as the adverse health risks associated with maternal overweight and obesity and pregnancy related weight gain. It examines the research evaluating clinician management of maternal weight across the perinatal period along with a review of the lifestyle interventions targeting maternal weight during pregnancy and following childbirth.

This thesis comprises four studies. In Chapter 3, the first of these studies is presented. Study 1 was a qualitative study of 28 general practitioners which documented their perspectives regarding gestational weight gain. That study described general practitioners’ attitudes, views and practices regarding the management of weight gain and existing barriers to management. Potential opportunities for provision of support for healthcare providers and women are discussed.

Study 2, detailed in Chapter 4 was a cross-sectional study of 448 first time mothers. Study 2 assessed the advice given to women regarding weight, diet and physical activity during pregnancy and following childbirth. Specifically, the advice provided by obstetricians and midwives is reported and associations of advice with weight, diet, physical activity and sedentary behaviours are assessed. The data for Study 2 were collected from the baseline survey of a cluster randomised controlled trial, the InFANT Feeding, Activity and Nutrition (InFANT) Extend trial.

Chapter 5 describes the methodology and results of Study 3, a pilot intervention study entitled the “mums OnLiNE” (mums Online, Lifestyle, Nutrition and Exercise) study. The intervention was informed by learnings from prior interventions and from results of Studies 1 and 2 of this thesis. The mums OnLiNE intervention study recruited a sub-sample of 28 first time mothers, concurrently enrolled in the intervention arm of the InFANT Extend trial. A description of the study recruitment, measures and outcomes, and details regarding the intervention content are given. The results of the mums OnLiNE intervention are presented, including data for the intervention group and two control groups with which comparisons were made. Data analyses and intervention outcomes related to maternal weight, diet, physical activity and sedentary behaviours are reported and discussed in detail.
In Chapter 6, the final study of the thesis is presented (Study 4). Study 4 was a qualitative study describing the experiences of a sub-sample of 12 women who completed the mums OnLiNE intervention. That study provides a qualitative evaluation of the intervention and presents recommendations provided by new mothers for future opportunities to best support women in their attainment of a healthy postpartum weight and healthy lifestyle behaviours.

Finally, the overall thesis findings are drawn together and discussed in Chapter 7. That chapter provides a summary of the key strengths and limitations of this thesis, discusses public health implications of the thesis findings, and makes recommendations for directions of future research.
Chapter 2
Literature review

2.1 Introduction

This chapter provides a summary of the literature describing current and future opportunities to promote healthy maternal weight during pregnancy and following childbirth. In Part 1, the prevalence of overweight and obesity in the adult population, particularly women of childbearing age is given. An overview of the increasing financial burden resulting from overweight and obesity in the adult population, and more specifically the pregnant population, is provided with a detailed review of the evidence linking maternal overweight and obesity with broad-ranging health implications, for both the mother and child. A description of the evidence linking diet and physical activity, to overweight and obesity across the perinatal period forms the conclusion of Part 1.

Part 2 provides detail regarding the current clinical management and interventions conducted to date, aimed at limiting gestational weight gain and postpartum weight retention. The interventions are discussed in detail, with a particular focus on describing the use of technology to deliver weight-loss and healthy lifestyle interventions. Opportunities for such interventions targeting first time mothers are discussed.
Part 1: Background

2.2 Overweight and obesity among adult women

2.2.1 Obesity prevalence, trends and implications for health

Overweight and obesity are defined as the abnormal or excessive accumulation of fat that may impair health (1). Body mass index (BMI), frequently used to classify overweight and obesity in adults, is an index of weight-for-height, defined by a person’s weight in kilograms (kg) divided by their height in metres squared (kg/m²) (1). The World Health Organization (WHO) international cut-points used to define overweight and obesity in the adult population are presented in Table 2.1.

Obesity is now considered a ‘global epidemic’ (2) and a priority area for public health intervention due to high prevalence rates (3) and associated morbidity and premature mortality (4). Worldwide, the prevalence of obesity has almost doubled over the past three decades (5, 6). The WHO estimated that in 2005, approximately 1.6 billion adults were overweight and a further 400 million were obese, predicting this number will almost double by 2015 (7).

Table 2.1 The WHO BMI cut-points for classification for overweight and obesity

<table>
<thead>
<tr>
<th>BMI classification</th>
<th>kg/m²</th>
</tr>
</thead>
<tbody>
<tr>
<td>Underweight</td>
<td>&lt; 18.5</td>
</tr>
<tr>
<td>Healthy range</td>
<td>18.5 – 24.9</td>
</tr>
<tr>
<td>Overweight</td>
<td>&gt;=25.0</td>
</tr>
<tr>
<td>Pre obese</td>
<td>25.0 – 29.9</td>
</tr>
<tr>
<td>Obese</td>
<td>&gt;=30</td>
</tr>
<tr>
<td>Obese class I</td>
<td>30.0 – 34.9</td>
</tr>
<tr>
<td>Obese class II</td>
<td>35.0 – 39.9</td>
</tr>
<tr>
<td>Obese class III</td>
<td>&gt;=40.0</td>
</tr>
</tbody>
</table>

In the US, overweight and obesity have increased by around 50% and in 2014 it was estimated that 2/3 of adults were overweight or obese (5, 9). Similarly in the UK, prevalence of overweight and obesity in both males and females is increasing (10) with 2/3 of adults classified as either overweight or obese in 2010 (11). The prevalence of obesity has also increased in several European countries over the past two decades (5, 12). A recent (2014) cross-sectional study conducted across 16 European countries (5) found that almost half (47.6%) of the sample of over 14,000 adults were overweight or obese (5). Similar rates are apparent in Australia, with the prevalence of adult obesity more than doubling over the past 20 years (13). Recent estimates have shown that in 2014, approximately 63% of Australian adults were either overweight or obese (14).

Overweight and obesity are now considered major risk factors for multiple chronic disease states and long term morbidity (15). Obesity has been linked to increased risk for type 2 diabetes mellitus (T2DM), stroke, heart disease, osteoarthritis, arthritis, gallbladder disease and some forms of cancer (16, 17). In addition, quality of life (18) and overall life expectancy (19) has been shown to be reduced in the obese population (20). In Australia, approximately two thirds of the adult population are at increased risk of developing obesity related health conditions (17), and recently the WHO estimated that non-communicable diseases, most of which are related to overweight and obesity, account for approximately 90% of all Australian deaths (17, 21). Moreover, a recent report ranked high BMI as the leading risk factor contributing to the overall burden of disease throughout Australasia (17, 22).

Evidence from mainly Caucasian populations and cross-sectional data indicates that abdominal obesity (defined in the US by waist circumference (WC) measures $\geq 102$cm for men and $\geq 88$cm for women) affects approximately 50% of the US population (23, 24) and 2/5 of the adult population (men 29%; women 48%) worldwide (23, 25). Abdominal obesity has been considered to be of greater importance in assessing increased morbidity and mortality risk, compared to obesity assessed by BMI (23, 26). Australian recommendations for WC measures are presented in Table 2.2.
Table 2.2 Australian waist circumference recommendations for increased chronic disease risk in Caucasian men and Caucasian and Asian women

<table>
<thead>
<tr>
<th>Gender</th>
<th>Increased risk</th>
<th>Greatly increased risk</th>
</tr>
</thead>
<tbody>
<tr>
<td>Men</td>
<td>&gt; 94cm</td>
<td>&gt; 102cm</td>
</tr>
<tr>
<td>Women</td>
<td>&gt; 80cm</td>
<td>&gt; 88cm</td>
</tr>
</tbody>
</table>

Source: Australian National Preventive Health Agency (2015) (27)

2.2.2 Overweight and obesity is more prevalent in women than men.

Globally, increases in rates of overweight and obesity seem to be more pronounced in women than in men (28). For example in 2005, Kelly et al (2008) analysed data from 106 countries to estimate the overall prevalence and absolute burden of overweight and obesity worldwide (29). Their data represented approximately 88% of the global population. The results showed that in all regions, the prevalence of obesity was consistently higher among women than men (29). Furthermore, in 2008 the WHO reported higher rates of obesity in females (14%) compared with males (10%) and more recent results from the Framingham Offspring/Spouse Nutrition Study (n=2,394) (23), show that over a 26 year follow up period, increases in mean BMI were greater in women compared to men and the prevalence of obesity doubled in men but tripled in women.

Likewise, in Australia, the prevalence of overweight and obesity in young adult women has increased significantly in recent years (30). Between 1995 and 2005, rates increased from 16% to 25% in 18-24 year olds and from 26% to 35% in 25 to 34 year olds (31). Increases in mean BMI over a similar period among women residing in south-eastern Australia have also been observed (32). Results from the Geelong Osteoporosis Study showed that mean BMI increased in women from 26.0kg/m² in 1993-97 (n=1,494) to 27.1kg/m² in 2004-08 (n=1,076), with the prevalence of morbid obesity also increasing from 3% to 4% in the same period (32). Increases in mean BMI and prevalence of morbid obesity were observed for all age groups and across the socioeconomic spectrum (32). In a separate 15-year follow up study of Australian men and women (n=1,621) (33), WC increases were significantly greater for women compared to men, with mean WC measures increasing by 0.12cm per year for men and 0.25cm per year for women (33).
2.2.3 Women of childbearing age are most at risk of overweight and obesity

Approximately half of all women of childbearing age in both the US (34, 35) and the UK (36) are either overweight or obese. Moreover, women of childbearing age (25-34 years) are at the greatest risk of substantial weight gain compared to men of all ages (37, 38). Further, compared to older women, those aged 18-36 years are gaining weight far more rapidly (39).

In Australia, women of childbearing age have been shown to gain weight more quickly than older women (39). Results from The Australian Longitudinal Study on Women’s Health (ALSWH), showed that women in their twenties gained weight at an average rate of 0.64kg/year which was 30% greater than the annual weight gain observed in 40-50 year old women (30, 40). Recent data (2011) has shown that almost 50% of women in Australia are entering pregnancy already overweight or obese (41, 42), a figure which was estimated as 35% one decade earlier (13, 43).

2.2.4 Overweight and obesity in women are associated with many adverse health outcomes

Multiple large international and national prospective studies have linked obesity to incident chronic disease in females (16, 44-46). These include increased risk of type 2 diabetes, stroke, osteoarthritis, gallbladder disease, heart disease, some forms of cancer (16) and depression (47). Obesity is a major risk factor for cardiovascular disease (CVD), the leading cause of mortality for women (48) and has led to more deaths among women compared to men since the mid 1980’s (48). In the US, one in five women has some form of CVD (47) and coronary heart disease (CHD) accounts for almost 50% of all CVD related deaths in females (47). Multiple gender differences in CHD have been documented and include later age of onset in women, a greater prevalence of co-morbidity and differences in initial disease manifestations (47).

Further, centrally distributed adiposity has been frequently associated with increased risk for CHD among females of varying age (47, 49-51). Recently, Canoy et al (2013) assessed the association of WC measures with risk of CHD in a large cohort of almost 500,000 middle-aged women in the UK. (52). Increasing WC was found to be associated with increased risk of a first onset of CHD and the risk was higher for women who had larger WC measures, whether they were a healthy BMI, overweight or obese (52). Moreover, in a pooled analysis
of data from approximately 650,000 male and female adults across Australia, the US and Sweden (53), a positive, linear association was found between WC and all-cause mortality for both men and women after adjusting for multiple confounding factors. Interestingly, the estimated decrease in life expectancy for highest versus lowest WC measures was roughly three years for men and five years for women (53).

2.3 The financial burden of overweight and obesity

2.3.1 Health costs and the public health burden of overweight and obesity

Increasing prevalence of overweight and obesity has resulted in an increased financial burden on healthcare systems throughout the world (20). For example, throughout parts of Europe overweight and obesity are responsible for a substantial economic burden, with estimated total costs ranging from 0.1 to 0.6% of total gross domestic income (15). In the US, total healthcare costs attributable to overweight and obesity are predicted to double every decade to reach approximately 18% of total US healthcare expenditure by 2030 (54). Moreover, costs attributable to obesity have been shown to equal or exceed smoking related costs (20, 55, 56), with the combined direct medical cost of overweight and obesity having been estimated as 5-10% of US healthcare spending (57). In the UK, direct obesity-related costs equate to 5% of total National Health Service expenditure (58), similar to expenditure data from the Netherlands (4%) and France (2%) (58).

Indirect medical costs (e.g. absenteeism, disability, workers’ compensation, productivity loss, decreased quality of life) are also incurred as a result of overweight and obesity with multiple studies having shown monetary value of lost productivity to be several times greater than medical costs (54, 59). In Sweden, obese individuals are 1.5-1.9 times more likely to take sick leave and 12% of obese women have obesity related disability pensions, together costing approximately US $300 for every adult woman in the population (54). Moreover, results from a systematic review of 31 studies assessing indirect obesity-related costs from several countries showed that compared with non-obese workers, obese workers missed more working days due to illness, injury or disability (59).
2.3.2 Health costs and public health burden of pregnancy related overweight and obesity

Whilst few studies have examined the relationship between maternal obesity and the financial burden placed on the healthcare system or the increased costs associated with antenatal care (60), obese women have been found to require greater healthcare resources during pregnancy compared to women of a healthy BMI (61). For example, in a large retrospective population-based cohort study conducted in several obstetric units in Scotland (n=109,592 pregnant women) (60), Denison et al found that compared with healthy weight women, those who were overweight, obese or severely obese experienced a 16%, 45% and 88% increase in the number of hospital admissions (60). Moreover, women who were overweight, obese or severely obese required significantly greater length of stay and contributed greater maternity costs, compared to women who were a healthy weight (60).

Similarly, Galtier-Dereure et al (2000) assessed duration of hospitalisation in standard obstetric or surgical units during pregnancy and the early postpartum period in French women (62). Forty two case-control pairs matched for age and parity were included in analyses. When both pre and post natal care was considered, women who had a pre-pregnancy BMI of > 29kg/m² were found to have an average 4.4 greater day length of stay in hospital than their leaner counterparts. Further, the average cost of hospital prenatal care was five times higher in mothers who were overweight pre-pregnancy than in normal weight control women (62). The duration of both day and night hospitalisation was also higher, by 3.9- and 6.2-fold respectively (62). These findings are consistent with data from a more recent US study conducted by Chu et al (2008), whereby compared to women with a healthy BMI, mean length of hospital stay for delivery was significantly greater for women who were overweight (3.7±0.1 days), obese (4.0±0.1 days), very obese (4.1±0.1 days) and extremely obese (4.4±0.1 days) (63). Increased length of stay was related mostly to increased rates of caesarean section delivery.

In Australia, Callaway et al (2006) assessed the prevalence and impact of overweight and obesity in 14,230 Australian women booked for antenatal care in a large maternity hospital in the state of Queensland (43). Compared to women of a healthy BMI, those who were overweight, obese and morbidly obese were found to be at increased risk for hospital stay longer than five days (1.36 times, 1.49 times and 3.18 times respectively) (43) after adjusting for multiple confounding factors.
2.4 Excess gestational weight gain defined

Weight gain as a result of childbearing is an important public health consideration and the literature suggests that childbearing is a period of increased risk for weight gain among many women (64). Evidence has shown that weight gained during pregnancy may be a crucial factor contributing to noticeable differences in weight gain during different stages of the lifespan (65).

2.4.1 Components of gestational weight gain

During pregnancy, women will naturally gain weight as a result of biological processes that seek to promote foetal growth (66). The pattern of gestational weight gain (GWG) is commonly referred to as sigmoidal, with the most significant weight gains occurring in the 2nd and early 3rd trimesters (66, 67). Whilst there may be individual differences in changes to body composition during pregnancy, a summary of the discrete physiological components of increased GWG has been outlined by Hytten (1991), and is often referred to in the literature (68, 69) for the purpose of describing GWG. The composition of GWG during pregnancy is shown in Table 2.3.

Whilst the average weight gain during pregnancy equates to approximately a 20% increase in body weight (70), studies evaluating body composition changes alongside total weight gain in the obstetric literature are rare (70). At term, total fat free mass (FFM) has been estimated to comprise roughly one third of total maternal weight gain (68, 71) and whilst the average contribution of fat stores to total GWG is approximately 72%, the total amount of body fat accumulated during pregnancy has been disputed (72). Nonetheless, women who gain more weight during pregnancy generally have been shown to have greater fat accumulation (70, 73).

Throughout the course of pregnancy, the greatest increases in maternal fat mass (FM) are often seen in the second trimester (68). Fat is deposited mostly in the maternal adipose tissue (85%) and the remainder in the foetus (14%) (71). In early to mid-pregnancy, women tend to deposit fat at their hips, back and upper thighs (68), and these deposits are thought to act as an energy store for later pregnancy and lactation (68, 74). However, total fat deposition for most women is greatest centrally as opposed to peripherally (68, 71). This is of concern, as central adiposity has been shown to be more strongly associated with negative health outcomes compared to body fat percentage and independent of BMI (75-77), as previously discussed in section 2.2.4.
Table 2.3 Composition of maternal weight gain during pregnancy and contribution to total weight gain

<table>
<thead>
<tr>
<th>Component of maternal weight gain</th>
<th>Weight contribution* (g)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Foetus</td>
<td>3294</td>
</tr>
<tr>
<td>Placenta</td>
<td>644</td>
</tr>
<tr>
<td>Amniotic fluid</td>
<td>795</td>
</tr>
<tr>
<td>Blood volume</td>
<td>1442</td>
</tr>
<tr>
<td>Uterus</td>
<td>970</td>
</tr>
<tr>
<td>Water^</td>
<td>1496</td>
</tr>
<tr>
<td>Breasts</td>
<td>397</td>
</tr>
<tr>
<td>Fat stores</td>
<td>3345</td>
</tr>
<tr>
<td><strong>Total gestational weight gain</strong></td>
<td><strong>12.4kg</strong></td>
</tr>
</tbody>
</table>

*Weight gain based on a total GWG of 12.4kg for a woman delivering a 3.3kg baby

^Extracellular and extra vascular water assuming no generalised oedema

Source: Hytten (1991) (71)

2.4.2 Gestational weight gain recommendations

There are currently no Australian guidelines for the amount of weight a woman should gain during her pregnancy and results from a recent systematic review assessing maternal weight policies showed a lack of consensus across sixty six countries in relation to GWG guidelines (78). However, in Australia and internationally the American Institute of Medicine (IOM) guidelines are often used as a benchmark when assessing and advising on GWG.

Whilst it has been suggested that a lack of experimental evidence exists supporting adherence to the IOM guidelines being associated with optimal pregnancy outcomes (78, 79), excess GWG is considered an important contributing factor to the observed obesity epidemic in women (80) and many adverse pregnancy outcomes have been considered potentially modifiable through achieving GWG within the IOM recommendations (80).
In 2009, the IOM published revised guidelines (67), based on the WHO criteria for pre-pregnancy BMI. These updated the 1990 IOM guidelines, and resulted from a review of the literature and efforts to optimise both maternal and neonatal health outcomes in the short and long term (69, 81). The 2009 IOM guidelines are presented in Table 2.4.

**Table 2.4 The IOM 2009 guidelines for gestational weight gain**

<table>
<thead>
<tr>
<th>Pre-pregnancy weight category</th>
<th>Pre-pregnancy BMI</th>
<th>Total Weight Gain Range (kg)</th>
<th>Rate of Weight Gain*2nd and 3rd Trimester (Mean Range in kg/week)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Underweight</td>
<td>&lt; 18.5kg/m²</td>
<td>12.5 – 18kg</td>
<td>0.51 (0.44 – 0.58)</td>
</tr>
<tr>
<td>Normal weight</td>
<td>18.5 – 24.9kg/m²</td>
<td>11.5 – 16kg</td>
<td>0.42 (0.35 – 0.50)</td>
</tr>
<tr>
<td>Overweight</td>
<td>25 – 29.9kg/m²</td>
<td>7 – 11.5kg</td>
<td>0.28 (0.23 – 0.33)</td>
</tr>
<tr>
<td>Obese</td>
<td>≥ 30kg/m²</td>
<td>5 – 9kg</td>
<td>0.22 (0.17 – 0.27)</td>
</tr>
</tbody>
</table>

* Calculations assume a 0.5–2 kg weight gain during the first trimester


The amount of weight a woman gains during pregnancy is variable and dependent on modifiable and non-modifiable factors, many of which are discussed in section 2.7. Excess GWG is defined as weight gain above the IOM recommendations and has been shown to be associated with a range of adverse health outcomes for both the mother and child (82). These are detailed in section 2.5. In the US, GWG for women giving birth to healthy term infants has been estimated to range between 10.0kg-16.7kg (68, 69), yet almost 50% of women exceed IOM recommendations for GWG (82, 83).

**2.4.3 Excess gestational weight gain is common and increasing**

The prevalence of excess GWG is increasing (69, 84). Studies conducted in the US between 1990 and 2007 show that more than 40% of women exceeded the 1990 IOM recommendations for GWG (85). More recently, in a nationally representative sample of US women, almost 50% gained in excess of the 2009 IOM guidelines (86, 87) and in a smaller sample of women enrolled in the Archive for Research on Child Health (ARCH) study (n=135), 56-60% of women were found to experience excess GWG (86).
In Australia, whilst studies assessing rates of excess GWG are lacking, data from a community based cohort study in 2010 (n=2,055) showed roughly one third of the study sample (33%) experienced excess GWG when compared to the 1990 IOM guidelines (88). Three years later, Hill et al (2013) reported that half of all women in Australia exceed the recommended GWG for their pre-pregnancy BMI (89). More recently, results from a prospective, multicentre cohort study conducted in 2014, which recruited women from Australia, the UK and New Zealand (n=1,950) reported much higher figures for excess GWG (90). In total, 74% of women experienced excess GWG when compared to the 2009 IOM recommendations (90).

Since the development of the 2009 IOM guidelines, there has been an increase in the number of published studies assessing GWG patterns in various countries and amongst women of varying BMI (86). For example, according to the Pregnancy Nutrition Surveillance System (PNSS) in the US, in 2010, 48% of women gained in excess of the IOM guidelines and overweight women and obese women were significantly more likely to gain more weight than recommended (59% and 56% respectively), compared with underweight (26%) or healthy weight (39%) women (86). Data from elsewhere have consistently shown that excess GWG is more common in women who are overweight or obese pre-pregnancy compared with women who enter pregnancy with a healthy BMI (90-92). For instance, a recent Canadian study reported that excess GWG is documented in 55-75% of women who enter pregnancy overweight or obese and in approximately 40% of women who have a healthy pre-pregnancy BMI (92, 93).

Importantly, regardless of pre-pregnancy BMI, excess GWG places a mother and her child at risk of many adverse health complications (94). Moreover, increasing prevalence of excess GWG is of concern as GWG is an important pathway for the development of postpartum weight retention (PPWR) (90) and the development of new or persistent obesity for women of childbearing age and their offspring (90), as outlined in section 2.5 and 2.7 below.

2.5 Maternal overweight and obesity and excess gestational weight gain are associated with multiple adverse health outcomes for the mother and child

Extensive literature has shown that both pre-pregnancy BMI and weight gain during pregnancy are associated with pregnancy outcomes (95). A large body of literature links maternal BMI with numerous maternal and foetal complications, presenting a continuum of risk from
preconception through to the inter-partum and puerperal period (96). In addition, GWG has been studied in depth as a predictor of adverse pregnancy outcomes (95) and is associated with a myriad of pregnancy related health complications.

2.5.1 Health complications of maternal overweight and obesity for the mother and child

The relationship between obesity and fertility is well established (97, 98). For example, in the Netherlands, 30% of sub fertile women are currently overweight or obese (99). Furthermore, in a large Dutch study, (n=3,029 sub fertile couples) Van der Steeg et al (2007) showed that obese women had a lower conception rate than women who were a healthy weight (100, 101) and data from observational studies and small intervention studies have suggested that weight-loss increases chances of conception in sub fertile women (99). Moreover, pre-conception obesity has also been associated with a reduced responses to fertility treatment (102, 103).

The risk for pregnancy complications appear to be higher with increasing pre-pregnancy BMI (104, 105). Over the past decades, multiple cohort and case-control studies have demonstrated clear associations between maternal overweight and obesity and a wide range of obstetric complications (105-108). In fact, maternal overweight and obesity has replaced smoking as the most important, preventable risk factor for adverse pregnancy outcomes in many countries (109, 110). Maternal obesity has been consistently associated with gestational diabetes mellitus (GDM) (2, 111-114), hypertensive disorders of pregnancy (112) including pre-eclampsia (2, 114, 115), prolonged pregnancy (2, 82), induction of labour (2), caesarean sections (2, 112, 116), and an increased risk of miscarriage whether obese women conceive naturally or via assisted reproductive measures (115, 117, 118).

Maternal obesity had been frequently shown to predispose women to pre-eclampsia (96, 119). Results from a systematic review of 13 cohort studies assessing approximately one million women showed on average that for each 5-7 unit increase in pre-pregnancy BMI, the risk of pre-eclampsia doubled (119, 120). In addition, large population studies have independently shown that obese women are two to three times more likely to develop pre-eclampsia compared with their leaner equivalents (96, 119). Likewise obesity has been repeatedly shown to increase the risk of developing gestational diabetes mellitus (GDM) (96, 121-124). In one study, the risk of GDM was shown to increase with increasing BMI to a relative risk (RR) of 1.7 in overweight women and 3.6 in obese women, compared with normal weight controls (96, 121).
Further, increased risk of caesarean section with pre-pregnancy obesity has been well documented (42, 125). Obese women have been shown to have a twofold increase in risk for a caesarean delivery compared with non-obese women (112, 125-128). Similar data were reported by Weiss et al (2004) (129) whereby the caesarean delivery rate for nulliparous women was 21% for women with a BMI $\leq 29.9$kg/m$^2$, 34% for women with a BMI of 30-34.9kg/m$^2$ and 48% for women with a BMI of 35-39.9kg/m$^2$ (129). Increased risk of both planned and unplanned caesarean section for obese women is concerning considering many further complications may arise. These include increased risk for post-operative complications such as infections or excessive maternal blood loss (115).

In Australia, a large study (n=11,233) (42) assessed pregnancy outcomes for the year 2008, according to maternal BMI, via the South Australian Pregnancy Outcome Unit’s population database (42). Overweight and obese women had an increased risk of GDM, hypertension, labour induction and caesarean section compared to women with a healthy BMI (42). Results were reported as being consistent with findings from other studies describing increased pregnancy related risks associated with maternal overweight and obesity (42, 95, 112, 130-135).

Obesity in pregnancy has also been shown to be associated with longer gestation (136, 137), significantly increasing the risk of post term delivery and higher need for induction of labour (133, 136, 138). An increased need for regional and general anaesthesia are also common concerns (115). Difficulty with placement of epidural or spinal anaesthesia in obese women can lead to multiple attempts being required (115), posing increased risk for anaesthetic complications. Further, general anaesthesia carries the risk of difficult intubation and the increased incidence of sleep apnoea during the postpartum period (115).

Maternal obesity is also associated with many well documented adverse neonatal health outcomes, including birth defects (139), anomalies of the central nervous system and heart (140-143), risk of preterm birth (109), shoulder dystocia, newborn intensive care unit (ICU) admission, foetal and neonatal death (144-146) and low APGAR (Appearance, Pulse, Grimace, Activity, Respiration) scores (147). Maternal obesity significantly increases the risk of neonates being born with neural tube defects (NTDs) (115, 148) and a recent systematic review and meta-analysis of 24 studies assessing the relationship between overweight and obesity with infant mortality (149) found that obese women had greater odds of having an
infant death, with the risk increasing with increasing BMI (149). In a separate systematic review of 38 studies, even modest increases in maternal BMI were found to increase the risk for foetal death and stillbirth (150).

In addition to the impacts on neonatal health, maternal obesity has been frequently associated with long term adverse health implications for the offspring (151, 152), including hypertension, dyslipidaemia, asthma, increased insulin resistance (153) and even premature death in adulthood (154). In a recently conducted prospective birth cohort study in Australia (n=2,779), Cameron et al (2014) assessed the association of maternal pre gravid BMI and offspring all-cause hospitalisations in the first five years of life (152). Results showed that children born to obese mothers had an increased risk of all-cause hospital admissions in the first five years of life, compared to children born to mothers of a healthy BMI (152). These findings highlight the intergenerational impact of maternal obesity (152) which adversely affect both maternal and child health and healthcare system burden (152).

2.5.2 Health complications of excess gestational weight gain for the mother and child

Not only has maternal overweight and obesity been associated with adverse maternal and child health outcomes, but excess GWG has also been shown to increase the risk of maternal complications (69, 155-157) and the effect has been shown to be independent of pre-pregnancy weight status (83). Specifically, excess GWG has been associated with increased risk of hypertensive disorders in pregnancy (90, 158) as well as non-elective caesarean delivery (90, 95).

In a case-control study conducted by Hedderson et al (2010), after adjustment for a range of confounding factors, risk of GDM was found to increase with increasing GWG (111). The authors acknowledged similar results from three prior studies, whereby excess GWG was found to be associated with an increased risk of impaired glucose tolerance during pregnancy, despite glucose levels not meeting strict criteria for diagnosis of GDM (111, 159, 160). The long term effects of excess GWG and development of diabetes has also been observed (94). For example, Mamum et al (2009) examined the long term impact of GWG in a sub-sample of 2,000 Australian women. Results showed that women who gained excess weight during pregnancy had increased odds of being diabetic 21 year post the index pregnancy (161).
In a separate and more recent study, Mamum et al (2011) analysed data for 6,632 women from the same original cohort to assess the independent associations of GWG with numerous adverse obstetric outcomes as well as length of postnatal hospital stay (94). Women who were obese prior to pregnancy and women who gained excess weight during pregnancy were found to be at greater risk for pregnancy complications (hypertensive disorders of pregnancy or GDM) and caesarean section delivery. Moreover, women who gained excess weight during pregnancy (0.19kg / day on average) stayed on average, longer in hospital compared with those who had adequate GWG.

Excess GWG has also been shown to be a strong predictor of both short and long term outcomes for the offspring (162). For example, in a retrospective cohort study of 20,465 non diabetic, singleton births, Stotland et al (2006) examined the relationship between GWG and adverse neonatal outcomes among term infants (82). Compared to women who gained within IOM guidelines, those who gained above IOM guidelines had higher unadjusted rates of neonates with a 5-minute APGAR score less than 7, assisted ventilation, special care nursery admission, seizure, hypoglycaemia, meconium aspiration syndrome, respiratory distress or tachypnoea and prolonged hospital stay. The authors reported that from a public health perspective, prevention of excess GWG should be a priority in the interest of women’s health and the health of the newborn (82).

2.5.3 Maternal obesity and excess gestational weight gain are associated with childhood obesity

Recent epidemiological studies have identified numerous perinatal factors that indicate a risk for later offspring obesity (163, 164). Increased rates of maternal obesity are paralleled by an increase in offspring obesity rates (35, 151, 165, 166). Whilst the mechanism remains unclear (167, 168), many observational studies report a positive association between maternal obesity and increased risk of obesity in the offspring as neonates (169-171), in childhood (164, 172-174) and even into early adulthood (175-177). In fact a recent systematic review and meta-analysis of 45 studies, conducted by Yu et al (2013), found an overall increased risk of pre-pregnancy overweight and obesity with subsequent offspring overweight or obesity (166). The risk for babies born large for gestational age (LGA), (defined as a birth weight above the 90th percentile for weight), macrosomic (birth weight above 4000g) and of a high body weight were also found to be increased (166).
Alongside increasing rates of maternal obesity over the past few decades, average birth weights have also increased in European and North American populations (115, 178). Multiple studies have consistently reported that infants born to obese mothers are at greater risk of being born LGA or macrosomic (82, 95, 140, 179, 180). Furthermore, macrosomic babies are at increased risk for shoulder dystocia (169) and insulin resistance compared with their non-macrosomic counterparts (169), highlighting the flow on effect of adverse health outcomes which may result from maternal pre-pregnancy obesity.

Excess GWG has also been shown to impact offspring birth weight. For example, Einerson et al (2010) reported results from a systematic review of the literature which found clear evidence that maternal weight gain exceeding IOM guidelines was associated with increasing numbers of abnormally sized infants, both LGA and also interestingly infants born small for gestational age (SGA) (83, 181). Savitz et al (2011) examined LGA and SGA as outcome variables related to GWG in a large cohort of 33,872 women in New York City (182). The results showed that term SGA decreased and LGA increased monotonically with increasing GWG (182). Further, mean birth weight showed a gradient of more than 200g from lowest to highest GWG categories (182).

As well, the effect of excess GWG can extend well past the time of birth and lead to higher offspring BMI (83, 161, 183) and has been shown to be one key, modifiable factor that appears to also be impacting childhood overweight and obesity rates (165, 167, 184, 185). Multiple studies have shown that greater GWG is associated with higher BMI in childhood (184, 186, 187), adolescence (165, 188) and adulthood (161). Moreover, recent longitudinal data has shown that once children are obese, their risk of remaining obese in adulthood is doubled (167, 189). As such, interventions aimed at reducing risk of obesity should occur early in life with prevention of excess GWG likely to play a key role in minimising onset of obesity in early infancy.

2.6 Excess gestational weight gain is linked to postpartum weight retention and subsequent adverse health implications

2.6.1 Excess gestational weight gain predicts postpartum weight retention
Excess GWG has been found to be the strongest, single predictor of PPWR (190-195) and the literature supporting a link between excess GWG and PPWR is well established (72, 155, 195-197). Even prior to development of the 1990 IOM guidelines for GWG, Scholl et al (1995) found in a sample of 274 low income women, excess GWG for women with a healthy pregravid BMI was positively associated with weight retention, maternal subcutaneous fat and overweight in the postpartum (198). Likewise, results from a Chinese study reported that excess GWG for women with a pre-pregnancy BMI in the normal range, was associated with higher PPWR at six weeks and three months (199).

More recently, Gore et al (2003) found that excess GWG was among the few primary risk factors for significant PPWR (37) when they summarised results from 12 studies; seven of which showed significant, positive associations (37). Similar results from Brazil have also been reported, although over a much shorter follow up period. Kac et al (2004) assessed the association between GWG and PPWR in a sample of 405 women (195). Pre-pregnancy weight was self-reported and weight was measured during pregnancy and at different occasions until nine months postpartum. Of the original sample, 208 women (51%) were followed up at nine months and the results showed that women who experienced excess GWG, had significantly higher weight retention, independent of pre-pregnancy BMI (195).

Over a much longer follow up period, Amorim et al (2007) assessed the association of excess GWG with long term BMI (200). Weight history data was retrospectively collected from obstetric records for 483 women across 14 different maternity units in Sweden, as part of the Stockholm Pregnancy and Women’s Nutrition (SPAWN) study. Women were then prospectively monitored up until 15 years postpartum. After controlling for pre-pregnancy BMI, GWG was found to be positively associated with BMI at 15 years follow up. The weight increase from baseline to 15 years postpartum was 6.2kg for women experiencing GWG below IOM recommendations, 6.7kg for women who gained within recommendations and significantly higher (10.0kg) for women who experienced excess GWG (200). In a more recent meta-analysis of nine observational studies assessing the association between GWG and long term PPWR, Nehring et al (2011) reported women who experienced excess GWG retained 3.0 kg and 4.7kg more weight at 3 and ≥15 years postpartum respectively, compared to those who gained within recommendations (201). Yet the observed associations may not be true associations due to a major weakness of many studies included in the review failing to adjust for confounding factors. Adjustment for smoking was attempted in only one study.
and the authors acknowledging that other potential confounding factors may be more relevant (201). Interestingly in 2014, Rong et al (202) conducted a meta-analysis of 17 observational studies assessing the association of GWG with PPWR. Results showed that in women with excess GWG, PPWR exhibited a U-shaped trend; a decline during the first year postpartum with a subsequent increase in the following period (202).

2.6.2 Postpartum weight retention is variable

Whilst many studies have identified associations between excess GWG and PPWR, it is important to acknowledge that the duration at which PPWR is assessed following pregnancy tends to differ considerably between studies (202). Some studies have focused on assessing weight retention in the short term (e.g. six weeks (203) to six months (204)), whilst few studies have tracked long term weight retention (e.g. 15 years) either solely or in addition to the early period following delivery (205). In their review of the literature assessing the role of postpartum weight retention in obesity promotion, Gore et al (2003) reported that difficulty may arise when drawing conclusions about the effect of pregnancy on PPWR, due to apparent methodological variations including inadequate follow up and use of self-reported pre-pregnancy weights (37). Study design weakness could therefore affect results by over- or under-estimating weight (37). Despite this, a consistent pattern has emerged regarding the association between degree of GWG and PPWR (37).

As with GWG, maternal PPWR also appears to be variable. Average PPWR may range from 0.5 to 3.0kg, with some women retaining up to 17.7kg (37). For example, a recent systematic review assessing PPWR across Asian countries identified 12 studies published between January 1990 and August 2010 and showed average PPWR to range from 1.6kg-4.1kg at six months postpartum (206). There is some suggestion however that mean PPWR may underestimate the impact of pregnancy and PPWR, as up to 20% of women may retain greater than 5kg at 6-18 months postpartum (207).

Short term postpartum weight retention

Walker et al (2004) assessed average PPWR and the proportion of women who attained pre-pregnancy weight in an ethnically diverse sample of 419 low income women at six weeks postpartum (203). Just 63 women (15%) were found to have attained their pre-pregnancy
weight at six weeks postpartum (203) and 49% of women who gained below IOM recommendations attained pre-pregnancy weight compared to 14% and 2% for those who gained within and above guidelines respectively (203). In a separate study, Walker et al (2006) assessed the trajectory of weekly weight change from delivery to six weeks postpartum in 26 low income women (208). Interestingly, trajectory of postpartum weight-loss did not occur at a constant rate during the first six weeks, but rather declined sharply during the first two weeks (208) and plateaued thereafter. It was suggested that reversal of pregnancy related physiological adaptations including changes in blood volume and fluid retention, would likely form the basis for weight-loss in the two weeks following delivery and as such this would have important implications for healthcare providers offering postpartum weight-loss advice or management (208). More recently, Lee et al (2011) assessed trajectory of maternal weight change in a sample of 120 Taiwanese women (204) from pre-pregnancy to six months postpartum (204). At six months postpartum, women were found to be on average 3.29kg heavier (+6.3% pre-pregnancy body weight) than their pre-pregnancy body weight (204). As maternal weight status in the early postpartum appears to be determined by physiological changes following giving birth (209), assessment of PPWR in the longer term might be more suitable than assessment immediately following labour.

**Long term postpartum weight retention**

Current evidence suggests that a single birth may result in a 2-3kg higher average body weight and an increased risk for long term overweight within 12 months to several years postpartum (191). For the majority of women, long term PPWR has been shown to range from 0 to 2kg (210-212), however studies tracking weight retention over an extended postpartum period (e.g. ≥ 12 months) have shown varied outcomes at different time points. For example, in a prospective cohort study in the US, Oken et al (2007) assessed weight retention in 907 women at one year postpartum (190). Average PPWR was 0.6kg, and ranged from -17.3kg to 25.5kg, with 12% of the study sample retaining ≥ 5kg. Moreover, in a Swedish obesity unit (n=128), PPWR ranging from up to 26.5kg to a loss of 12.3kg was observed at one year postpartum, although average weight gain was just 0.5kg (194).

Weight retention at one year postpartum may also impact weight status in the longer term. Linne et al (2004) conducted a longitudinal study of 563 Swedish women as part of the larger
SPAWN study and assessed PPWR at 12 months and 15 years follow up (205). At 12 months postpartum, mean weight gain was 1.4±3.5kg and just over one third of the women returned to pre-pregnancy body weight, or weighed less than pre-pregnancy (205). Weight gain was significantly greater and weight trajectory steeper for high weight retainers (10.3±7.9kg) compared to low weight retainers (5.3±6.5kg) and intermediate weight retainers (7.6±6.9kg) from pre-pregnancy to 15 years postpartum (205). The authors concluded that the trajectory was a direct result of failure to lose weight gained during pregnancy within the first 12 months postpartum (205).

The postpartum is a period of common weight gain progression and has the potential to be influential across a woman’s life. Understanding how we can best support women to attain and sustain healthy weight in the postpartum is important. Whilst many studies report differences in average postpartum weight retention, the literature shows that weight gained during pregnancy often tracks into the short and long term postpartum period. Therefore further assessment of predictors of weight retention (203) should receive greater focus, in the interest of healthy maternal weight attainment.

2.6.3 High postpartum weight retention is associated with adverse health implications for subsequent pregnancies

In a prospective cohort study (n=1,300) Gunderson et al (2000) found that excess GWG was among the few factors associated with a two-to-threefold increase in risk of becoming overweight by the beginning of a second pregnancy (65). Even for women who are not necessarily overweight or obese, weight retention between pregnancies can increase risk for adverse health complications during subsequent pregnancies. For example, in a population-based cohort study in Belgium, Bogaerts et al (2013) examined the association between inter-pregnancy weight and the risk of poor maternal and neonatal outcomes (213) in 7,987 women who had previously delivered their first two consecutive births between 2009 and 2011. The results showed weight retention between pregnancies was associated with an increased risk for complications including pregnancy induced hypertension, caesarean delivery and macrosomia, even in underweight women and women with a healthy BMI (213).

In addition to weight retention, inter-pregnancy weight gain has also been shown to be associated with increased risk of complications in the subsequent pregnancy, regardless of
whether a women is overweight or not (214, 215). In fact a weight gain of 1-2 BMI units between pregnancies has been shown to increase the risk for GDM, hypertension and babies being born LGA by approximately 30-40% (215). Hence, optimising support to promote healthy weight attainment during the postpartum period is of vital importance, considering that the majority of women will attempt to become pregnant for a second time in the first few years after the birth of their first child (214).

Furthermore, inter-partum weight-loss has been shown to offer potential in improving neonatal outcomes for subsequent pregnancies (216). Jain et al (2013) recently assessed inter-partum weight change in a population-based cohort study of obese women (n=10,444) who had delivered their first two singleton infants between 1998 and 2005 (216). Whilst inter-partum weight gain was associated with increased risk of babies being born LGA, weight-loss was associated with lower risk of an LGA infant being born (216). Therefore, promoting a healthy maternal BMI between pregnancies may have the capacity to positively influence maternal and child health outcomes as well as offspring birth weight.

2.6.4 High postpartum weight retention is linked to long term adverse health implications

Postpartum weight retention could be a factor contributing to the development of overweight, obesity and associated conditions including heart disease and diabetes (16, 207). For example, even modest amounts of weight retention have been associated with increased risk for CHD over a 14 year period (16, 217). Further and importantly, weight retention as a result of pregnancy related weight gain tends to be centrally rather than peripherally deposited (218-220). Since central fat distribution is a well-established risk factor for morbidity and mortality, assessment of PPWR is an important consideration for public health research (218).

Likewise, the literature has shown associations between PPWR and highly prevalent weight gain among young adult women (37, 221). For example, Rooney and Schaubeger et al (2005) estimated the long term impact of perinatal weight change on obesity, weight gain and onset of obesity related illness in 484 women (16). At 15 years postpartum, 30% of the women were found to be obese, 27% were overweight, 39% were normal weight and 4% were underweight. Examination of rates of obesity related disease across BMI categories showed that 12% of the women had been diagnosed with or had ≥ 3 of the five risk factors for metabolic syndrome and 13% had diabetes or pre diabetes; rates which increased significantly with increasing BMI.
category (0% of underweight women, 2% of normal weight women, 4% of overweight women and 38% of obese women). When combined, 30% of women had CHD or pre CHD, the rate of which also increased significantly with increasing BMI category (10% of underweight women, 17% of normal weight women, 30% of overweight women and 51% of obese women). The authors concluded that change in weight by 15 years postpartum was indirectly related to disease, in that women who failed to lose pregnancy related weight gain by six months postpartum were at increased risk of excess weight gain at 15 years and consequently were at higher risk of developing diabetes/pre diabetes or CHD/pre CHD (16).

In summary, results from the available literature show that PPWR is associated with adverse health implications during subsequent pregnancies and with long term overweight and obesity and associated chronic disease risk. The postpartum period is therefore an important time in which to promote the attainment of healthy maternal weight with the intention of reducing the risk for a number of overweight and obesity related adverse health conditions.

2.7 Women’s lifestyle behaviours contribute to overweight and obesity during pregnancy and following childbirth

Given the personal, health and economic costs of overweight and obesity (17), research assessing the determinants and consequences of unhealthy weight and weight gain is particularly important (17). Moreover, since young adult women (18-36 years) are gaining weight at higher rates than women in other age group (30), and considering the many adverse health implications associated with excess GWG and maternal obesity across the perinatal period, understanding the modifiable lifestyle behaviours associated with weight gain in this population is key. Both poor dietary habits and insufficient physical activity (PA) have frequently been associated with long term weight change, weight gain (222) and in the development and maintenance of obesity (223-226). As such, modifiable dietary and physical activity behaviours have become major targets for healthy weight intervention and obesity prevention strategies. Therefore, insight into these habitual behaviours throughout the reproductive cycle in necessary in order to design effective management strategies aimed at assisting women in achieving healthy lifestyles across the perinatal period (227).
2.7.1 Lifestyle behaviours contribute to excess gestational weight gain

As diet and PA influence the energy balance which largely determines weight gain, they are anticipated to contribute to excess GWG as they would in the non-pregnant population (228). Typically, women have been found to increase caloric intakes during pregnancy, in excess of their nutritional needs (229). Results of some studies have identified poor dietary behaviour and insufficient PA as correlates of excess GWG (219, 228, 230, 231). For example, in a systematic review of 12 observational studies, five of the 12 studies included suggested significant positive associations between energy intake and GWG, whereas three studies found no association (232). Further, significant associations of GWG were reported in the remaining studies and included protein intake, animal fats, energy density and food servings per day (232).

Although basic healthy eating and PA principles should be encouraged during pregnancy and following childbirth (233), pregnancy is influenced by morning sickness, food cravings and food aversions as well as the common misconception promoting ‘eating for two’ (233). Interestingly, a recent qualitative study of overweight and obese women conducted in the US found clear differences in the dietary habits of women who experienced recommended versus greater than recommended GWG (233). Women with excess GWG were found to frequently adopt the message ‘eating for two’ during pregnancy, which often resulted in significant increases in overall food intake compared to pre-pregnancy dietary habits (233).

However, dietary behaviours of women have been shown not to change markedly from pre-conception to during pregnancy. For instance, Crozier et al (2009) (234) assessed dietary patterns of 12,572 non-pregnant women aged 20-34 years as part of the Southampton Women’s Survey (SWS), 2,649 of whom then provided dietary data during pregnancy. Results showed little change in dietary patterns and indicated that, overall, women did not improve their dietary intakes during pregnancy (234). Further, in a nationally representative sample of over 7,000 Australian women enrolled in the ALSWH (235), consumption of a wider variety of nutritious foods when planning to become pregnant, or during pregnancy was shown not to significantly increase from pre-pregnancy (235). Pregnancy status was found not to be predictive of diet quality before or after adjusting for area of residence and socioeconomic status.

Equally as important as assessment of dietary behaviours, is the assessment of associations of maternal PA with GWG. Insufficient PA during pregnancy has been previously associated with
excess GWG (236). Mottola and Campbell (237) examined PA associated weight gain during pregnancy and found that women who had gained more weight by their third trimester (defined as increases by 10kg increments) were 1.54 times more likely to have discontinued their involvement in planned PA (237). Likewise, in the qualitative study with overweight and obese women described above, Chuang et al (2014) found that nearly all women who experienced excess GWG exercised less during pregnancy or were sedentary compared to women who gained weight within GWG recommendations and who increased or maintained pre-pregnancy PA levels (233). Yet several studies designed to decrease excess GWG have shown no effect (91, 238-240). Recently, Chasan-Taber et al (2014) assessed the association of PA with excess GWG, compliance with GWG guidelines and rate of GWG amongst Hispanic women (n=1,276) (238). Results showed statistically significant associations between type or intensity of PA and any of the GWG outcomes (238).

Regardless of the potential associations between PA and GWG, PA during pregnancy has been linked with numerous maternal health outcomes independent of GWG and fat mass (241). Physical activity during pregnancy has been associated with reduced risk of pre-eclampsia (242, 243), GDM (242, 244) and preterm birth (242). The US guidelines recommend that healthy women participate in at least 150 minutes of moderate intensity aerobic activity each week during pregnancy (245). In Australia similar guidelines promote regular moderate activity and safe levels of vigorous PA during each trimester (246). Yet it has been estimated that up to 60% of women remain inactive during their pregnancy (247). Both retrospective and prospective studies report decreased levels of leisure time and work related PA across pregnancy (247). Elsewhere, it has been documented that as pregnancy progresses, PA tends to decline. Results of a recent review of 31 studies exploring PA patterns during pregnancy showed that PA levels decreased as pregnancy advanced (247). Likewise, in their recent review of 25 studies assessing patterns and determinants of exercise during pregnancy, Gaston et al (2011) found that PA decreased in frequency and intensity from pre-conception to during pregnancy in the majority of studies and that few women met PA guidelines (241). In addition, pregnant women were found to be less active than their non-pregnant counterparts.

The reasons PA has consistently been shown to decrease during pregnancy progression have been reported as numerous and complex (241, 247). Barriers such as fatigue and nausea, reported commonly in the first trimester (247) may contribute to a decline in PA or prevent initiation of regular PA during pregnancy while physiological adaptations such as uterine
enlargement in the last trimester may effect maternal decisions to remain active (247). Interestingly, women who are active prior to pregnancy tend to remain more active during pregnancy (241). In fact the strongest predictor of PA during pregnancy has been shown to be PA level in the 12 months prior to pregnancy (248). This supports justification for directing PA interventions towards women who are planning to have children (241), either prior to their first pregnancy or between pregnancies. In any case, better understanding the dietary and PA patterns of pregnant women will enable further insight into when and how best to promote positive maternal behaviour and support healthy maternal weight gain.

2.7.2 Lifestyle behaviours contribute to overweight and obesity during the postpartum period

Importantly, both PPWR and long term development and persistence of obesity in women have been attributed to suboptimal diet and PA behaviours (30). Therefore, these modifiable behavioural risk factors are suitable targets for healthy lifestyle interventions (249). Whilst dietary and PA strategies to target PPWR are discussed in detail in section 2.9.2, it is important to note that interventions which have successfully limited PPWR have usually included both diet and PA intervention components (250-252). Interestingly, a recent survey conducted in Iran showed that diet and PA are the most important, modifiable factors associated with PPWR (253). Elsewhere, PA and poor dietary intakes have been shown to contribute to PPWR and obesity following childbirth (194). Hence, it is important to assess the overall contribution of poor dietary and PA patterns to PPWR.

As the postpartum period is a time often characterised by not only weight retention but also weight gain (254), this is a particularly important time to assess the dietary habits of new mothers in relation to their weight and overall health. Following childbirth, healthy eating is important to adequately support breastfeeding (255) and to demonstrate healthy role modelling behaviours for infants (255). Adequate fruit and vegetable intake is important for reduced chronic disease risk (256). Better understanding the dietary behaviours of new mothers will inform future strategies to assist promoting optimal dietary intakes in this important population group.

Whilst few data exist assessing the associations of diet quality with PPWR specifically, dietary habits of women in general have been found to be sub-optimal across many adult population groups (257-259). Results from a recently published US study assessed whether diet quality
(defined according to the previously validated Framingham nutritional risk score (FNRS) (260, 261) was associated with the development of overweight or obesity, over a 16 year period, in 590 women (BMI < 25kg/m²) aged 25 to 71 years (261). The FNRS was found to be directly related to overweight or obesity ($P$ for trend = 0.009). Women with a lower diet quality were significantly more likely to become overweight or obese, compared to those with a higher diet quality, after adjusting for age, PA and smoking as confounding factors.

The literature has also reports associations of diet with central obesity (226). For example, findings from a recently published Australian study showed that poor dietary intake was the key predictor of a ≥ 5% increase in WC from baseline to follow up five years later in women aged ≥ 25 years (262). Moreover, a greater proportion of women (38%) compared with men (27%) experienced a ≥ 5% gain in WC during the 5 year study period.

Assessment of maternal PA behaviour during the postpartum period is important in order to establish potential opportunities for promoting adequate levels of PA among new mothers. Despite the many well documented health benefits of adequate PA during the postpartum period, including improved cholesterol levels, better insulin sensitivity (263, 264) and improved mental health (265), some studies have found women to be less active following childbirth compared to pre-pregnancy (266, 267), whilst others have shown that PA in the postpartum period actually increased or rebounded compared to levels during pregnancy (268, 269).

Regular PA during the postpartum period has also been associated with increased chance of women returning to pre-pregnancy weight (263, 267, 270, 271), reduced PPWR (272) and with beneficial weight change from early pregnancy to one year postpartum (64). In contrast, low levels of PA in the postpartum period can promote weight retention (273). Recently Bauer et al (2014) assessed the relationship between PA at three months postpartum, retrospectively reported at six years postpartum, with PPWR (274). Results showed that PPWR was significantly and inversely associated with past and current postpartum leisure time PA (LTPA) (274). Women who were classified as sufficiently physically active retained less weight at six years postpartum, compared with those who were not (274).

The postpartum period has been considered an opportune time to engage with women in planning and practicing life long lifestyle behaviours (275). It is also a time whereby many
women do not achieve optimal dietary behaviours or sufficient levels of PA. Following childbirth, women encounter many unique lifestyle adaptations and the period of change, particularly for first time mothers can present many barriers to making healthy lifestyle choices (275). Hence, it is important to assess the current management strategies employed to support women in their attainment of healthy maternal weight and healthy behaviours across the perinatal period, so that future opportunities for additional provision of support may be identified.
2.8 Clinical management of maternal weight during pregnancy and the postpartum period

In comparison with the vast amount of literature documenting maternal and child health risks associated with maternal overweight and obesity, fewer studies have focused on clinical management of maternal weight across the perinatal period. Maternal obesity is considered one of the most commonly occurring risk factors in obstetric practice (276) and healthcare providers are increasingly faced with providing care for women who are overweight or obese during and following pregnancy. Whilst the delivery of antenatal care differs across countries, a number of health professionals including general practitioners (GPs), physicians, midwives and obstetricians deliver such services throughout pregnancy (277).

Midwives, and GPs with a focus on the physiology of pregnancy and childbirth are often first choice providers of maternity care for women considered at low risk for complications (278). Obstetricians are specialised in providing antenatal care for women with obstetrical risks or complications that may lead to adverse maternal and child health outcomes (278). In Australia, women often elect to have their antenatal care managed by their GP and obstetrician or hospital midwife. This system is known as ‘shared care’. Regardless of the format of care provided, women seek advice from their healthcare provider frequently throughout their pregnancy (279). With many occasions to engage women from early pregnancy onwards, clear opportunities to support women to achieve positive lifestyle behaviours which will promote healthy weight gain both during pregnancy and in the postpartum are available. In addition, health professionals are often viewed as authorities regarding maternal health information both during pregnancy (279, 280) and following childbirth (281), and as such it is key to assess their role in provision of support for healthy weight attainment.

2.8.1 Management of gestational weight gain and barriers to provision of support

The ideal management of gestational obesity in particular, remains poorly defined (282). Some literature has assessed whether or not clinicians provide weight gain advice during pregnancy and whether advice provided is consistent, with results showing a lack of uniformity in clinical
practice. For instance, Brawarsky et al (2005) found that in the US, between 32 and 36 weeks gestation, over one third of their sample (n=1,100) reported receiving no advice on how much weight to gain during pregnancy (283). More recently, Tovar et al (2010) analysed data from focus groups with 29 women (284). The majority of overweight and obese women reported they had not received any recommendations for GWG from their physician and when they did receive advice, recommendations for the amount of weight to gain were varied (284). However the study sample was limited to Peuto Rican women, a group who have higher rates of obesity compared to non-Hispanic white women (284). In contrast, in a sample of Dutch women (n=144) at 30 weeks gestation, only 12% of the study sample reported not receiving any advice from their practitioner regarding GWG (228).

The small number of healthcare providers who do advise their patients on weight gain during pregnancy might not be recommending GWG in accordance with IOM guidelines (66), particularly for overweight or obese women (66, 285). For example, in a recent cross sectional study which utilised a highly diverse socioeconomic and ethnically diverse sample, Phelan et al (2011) assessed receipt of GWG advice in prenatal care with expected GWG outcomes for normal (n=203) and overweight/obese (n=198) women (285). Women were < 16 weeks gestation and were recruited at their first prenatal visit as part of the Fit for Delivery study (285). Results showed that less than half (42%) of women reported receiving weight gain advice from a healthcare provider. Yet of those who did receive advice (n=167) the majority of women (85%) reported receiving advice consistent with IOM recommendations for GWG (285). As the study focused on early pregnancy only, it is possible women may have received weight gain advice later during pregnancy which was not reported, and which is therefore not indicative of clinical management throughout all three trimesters.

In an earlier study, Cogswell et al (1999) found that of their sample of 2,237 women, 27% reported that they had received no advice about GWG during their pregnancy and among those who did receive advice, 36% were advised to gain weight inconsistent with IOM recommendations (286). These results are similar with those of Althuizen et al (2009) who found that 28% of participants in their study reported receiving advice outside of the IOM recommendations, although theirs was a smaller sample size in comparison (n=144) (228).

Despite the US IOM guidelines for GWG often being used in clinical practice, currently in Australia no formal recommendations exist for the amount of weight a woman should gain
during pregnancy. Therefore, it is not surprising that a recent qualitative study conducted in Australia (2012) (287), found that midwives considered GWG a low priority in their antenatal practice (287). The results were consistent with those from a survey of 241 midwives in the UK (288) whereby only 15% of respondents offered individualised GWG advice based on the women’s diet and PA (288).

Similarly in the UK, no formal guidelines for GWG are in place and healthcare provider advice has been reported to vary (228, 285). Of 16 maternity units across a range of locations within the North East region of the UK, most (12 units) had previously been identified by a sample of obstetric and healthcare workers as discussing weight gain recommendations with women (289). Yet none of these units were reported as having a policy or guideline in place to provide consistent weight gain recommendations (289). In contrast, Olander et al (2011) used focus groups to assess both women’s views (n=23) and the views of healthcare providers (n=8) regarding GWG (279). Overall, women reported that they did not receive any advice from their healthcare professional during pregnancy about how much weight to gain (279) and that they assumed that midwives would discuss and inform them of appropriate weight gain if it was an important issue. Moreover, they reported that receiving advice from their midwife regarding their GWG would be useful (279). The healthcare professionals reported that their knowledge and opportunity to provide women with information regarding GWG was limited and that GWG issues should be discussed sensitively.

When healthcare providers do use target GWG as part of their practice, studies suggest that women often adhere to guidelines. Women’s actual weight gain during pregnancy has been shown to be strongly correlated with advice provided by the clinician (66, 286, 290). For example, Cogswell et al (1999) found that women who received advice from their healthcare provider to gain within IOM limits were twice as likely to gain weight within those ranges compared to women who received no advice (286). Similarly, Brawarsky et al (2005) found that women who received physician advice to gain less than IOM recommendations were most likely to have inadequate GWG, while those who received advice to gain above recommendations were most likely to experience excess GWG (283). In a Dutch sample of 144 women, factors associated with maternal overweight and obesity during pregnancy and weight gain in excess of IOM recommendations were assessed via self-reported data at 30 weeks gestation and self-reported weight at six weeks postpartum (228). Univariate analysis showed that receiving weight gain advice in excess of recommendations was significantly associated
with excess GWG. However, provider advice was highly correlated with pre-pregnancy BMI and as such multivariate analysis was not included in the results (228).

Although some insight has been gained from the few studies which have documented the advice regarding GWG provided by a range of healthcare providers the literature to date assessing the overall management of GWG from the healthcare providers’ perspective is scarce. Further investigation is therefore needed to inform opportunities for providing consistent information across a number of different antenatal disciplines to optimise maternal and child pregnancy outcomes.

Whilst it is apparent that advice provided to women regarding weight gain during pregnancy and the management of GWG throughout pregnancy is inconsistent, barriers to provision of support warrant investigation. The literature is scarce, however previously identified barriers to weight related support from antenatal healthcare providers have included lack of knowledge regarding GWG (279), training, teaching materials and staff support. Yet physicians have previously acknowledged that providing identification and treatment of weight options should be within the scope of their practice (279, 291).

For example, Stotland et al (2010) published results from a study which used several focus groups to assess the knowledge, attitudes and practices regarding prevention of excess GWG approaches to nutrition and PA counselling during pregnancy (277). Participants were a convenience sample of 52 healthcare professionals including general obstetricians, gynaecologists, midwives and nurses, drawn from a variety of clinical practice settings in the San Francisco Bay area (277). Results showed that almost all of the healthcare providers recognised weight gain, nutrition and PA as important topics, with potential to impact the health of the mother and child (277). Many of the healthcare providers in that study reported taking part in the focus groups to find out how their colleagues assess and manage GWG (277), highlighting that routine practice was non-existent among the group.

In Australia, Schmied et al (2011) used focus groups and one-on-one interviews, to document the experiences and concerns of health professionals who cared for obese childbearing women (292). Participants (n=34 midwives; n=2 obstetricians; n=1 anaesthetist) were drawn from three hospital sites within two health service areas in New South Wales. The results showed that, overall, participants were unsure of how best to address the issue of obesity with a woman and
that there was variability in communication approaches. Further, healthcare providers reported there was a lack of appropriate equipment available for managing obese women and that the need for policy and service planning to reduce occupational health and safety concerns in assisting obese women was needed, but to date had not yet occurred (292).

Healthcare professionals face difficulty when managing obese women during pregnancy, as obesity has previously been viewed as an emotive and somewhat stigmatising topic to be addressed in the clinical setting (293). Likewise in the non-pregnant population, fear of negative patient reactions to weight issues being addressed by physicians has been identified as a barrier to patient weight management (294). Lack of strategies to adequately provide suitable counselling, without negative impact, has been identified as a barrier to the provision of GWG advice (277, 292).

Whilst pregnant women might be particularly motivated to make healthy lifestyle changes out of concern for the health of their offspring (277, 295), both locally and internationally there are clear inconsistencies in the way healthcare providers view and manage GWG. Despite many well documented adverse implications of excess GWG both for the mother and child, there is a lack of formal recommendations across many countries for the amount of weight a woman should gain during pregnancy. Lack of consistency in guidelines is one of many other barriers healthcare providers face in their management of GWG and their provision of healthy lifestyle advice. Further investigation is needed to assess the views of healthcare providers in relation to GWG management.

2.8.2 Management of maternal postpartum weight and barriers to provision of support

Studies assessing how healthcare providers view and manage maternal weight in the postpartum are lacking (296). Clinicians involved in the postnatal care of women are not accountable for reviewing weight goals or developing weight-loss plans with their patients (196). Traditionally, compared with during pregnancy, less opportunity presents in the months following childbirth for women to be seen by a healthcare provider specifically for their own weight management. The absence of regularly occurring postnatal consultations following pregnancy likely reduces the opportunity for healthcare providers to address weight retention adequately.
Further, advice regarding weight-loss or PA is not included on the postpartum checklist in some practitioner guidelines for perinatal care (296). Included in the NICE (2010) guidelines for postnatal care, weight assessment and advice for weight-loss have been recommended to form part of the postnatal follow up, however whether healthcare providers routinely follow these recommendations remains unclear. This is of concern as it has previously been estimated that by the six week postpartum follow up consultation, less than one third of women will have reached their pre-pregnancy weight (297), irrespective of their pre-pregnancy BMI. However, women have been found to consistently report that their weight is less important during pregnancy compared with the postpartum period (279, 284, 298) and that they are more motivated to address their weight following childbirth (298).

In North Carolina, Ferrari et al (2010) prospectively assessed the association between provider advice regarding postpartum weight-loss and PA, with weight retention and activity levels in women (n=688) at three months postpartum (296). The results showed that the majority (89%) of women reported receiving no weight-loss advice and no PA advice (78%) from their healthcare provider during the three month postpartum period (296). However the study was limited in that the majority (76%) of the sample were white, had an education qualification higher than high school (83%) and reported an income > 185% of the federal poverty line (81%), limiting generalisability of results.

During the postpartum, extended care which includes weight-related assessment and management is one option for reducing the risk of childbearing becoming a transitional event for weight gain and obesity (297). Care in the postpartum would ideally include periodic visits to clinicians to provide support and education for weight changes, increased PA and healthy dietary habits (196). Walker et al (2004) (203) have argued for extended postpartum care to include periodic visits to providers to focus on support and education for weight management, PA and healthy eating behaviours (203, 297).

Healthcare providers have previously acknowledged the need for lifestyle intervention to assist in promoting healthy weight gain during pregnancy and healthy weight attainment in the postpartum. Oteng-Ntim (2010) conducted a qualitative study to assess the views of service providers in London, UK regarding the development of multi-component interventions for obese pregnant women (299). Twenty-two healthcare professionals from nursing, obstetric, physician and allied health departments took part in one-on-one telephone interviews which
were later analysed using a modified version of ‘framework analysis’ (299). Overall the healthcare providers acknowledged existing inadequate service provision and management of obese pregnant women and acknowledged a need for the design and implementation of a multi-component intervention targeting healthy eating and PA both during and following pregnancy (299). Views regarding whether the service should be group based or one-on-one were mixed. One-on-one sessions were favoured for their ability to provide individually centred care and group based sessions viewed as being advantageous due to peer support, which would potentially help motivate patients (299).

In summary, reducing the adverse health outcomes associated with maternal overweight and obesity has been identified as a public health priority (300). Yet far less is known regarding provision of support for maternal weight during the postpartum period, compared with during pregnancy. There appears to be less opportunity for face-to-face, weight-focussed appointments for women with healthcare providers following childbirth. As such, the postpartum period might be considered a missed opportunity for provision of support, to assist women in returning to pre-pregnancy weight or in attaining a healthy BMI for subsequent pregnancies and for the long term. Suitable interventions that support existing practice, without adding to the cost and time burden placed on antenatal practitioners, might be a successful approach in addressing the issue. Interventions which aim to improve weight status of women in the postpartum would reduce the number of women entering their subsequent pregnancy at a high BMI, as overweight or obese (196). In a public health context, reducing inter-partum weight is likely to be an effective strategy in targeting long term obesity risk as a consequence of weight gained during pregnancy and retained in the postpartum. In the interest of short and long term maternal heath, further research is necessary to better understand healthcare provider engagement with women during this important life stage.

2.9 Summary of lifestyle interventions aimed at limiting excess gestational weight gain and postpartum weight retention

2.9.1 Interventions aimed at limiting excess gestational weight gain

Numerous interventions have been conducted aimed at limiting GWG to within recommended levels (301). Compared with during the postpartum period, a greater number of interventions have been delivered to women during pregnancy, and have been the topic of several, published
reviews over the past five years including a Cochrane review in 2012 (162, 301-305). Collectively, findings from these reviews suggest that interventions aimed at limiting excess GWG thus far have had limited effectiveness (301, 306). Only subtle reductions in GWG (307) have been observed. Moreover, a recent systematic review conducted by Eliot-Sale et al (2014) reported findings from an earlier Cochrane review conducted by Muktabhant et al (2012), highlighting there was insufficient evidence to recommend any intervention, including exercise, for preventing excess GWG (308, 309). More specifically, there has been little evidence to suggest that interventions conducted during pregnancy are effective at preventing excess GWG to within IOM recommendations (301, 305). The majority of successful interventions have been viewed as not being easily disseminable (306), and many have relied on face-to-face counselling in their intervention delivery (91, 310, 311).

Of the interventions which have targeted excess GWG and had successful outcomes (91, 239, 312, 313), few have utilised technology in their delivery (306). Those which have included telephone support (91, 239, 314) and more recently text messaging via mobile phone devices (306) have shown promising results. Self-monitoring of behaviour change has also been shown to have a beneficial effect on excess GWG across many studies (301). Specifically, Streuling et al (2010) identified weight monitoring to be associated with successful interventions (301, 303). For example, an Australian study conducted by Jeffries et al (2010) (315) utilised a weighing approach without the inclusion of a diet/or PA intervention component. Women measured their own weight gains and recorded personal weight goals compared with recommendations. The intervention was successful in limiting GWG for overweight women with a mean significant difference of 0.12kg/week (95% CI, 0.03 to 0.22kg/week). No significant impact was observed for underweight, healthy weight or obese women (315).

Unlike the findings from reviews assessing postpartum interventions (presented in section 2.9.2), dietary focussed interventions have been found to be the most consistently effective approach to limiting GWG (301, 305). Hill et al (2013) recently proposed that supportive programs which utilise a combination of behaviour change theories and a dietary intervention focus may be most effective in limiting GWG (301). This was despite a main finding of the review that intervention studies based on theory were as effective, overall, as those which were non-theory-based (301).
In summary, with many uncertainties remaining regarding preferred methods of support for women during pregnancy, promoting healthy GWG is challenging. Given that in Australia approximately half of all pregnancies are unplanned (316) and that 50% of the population are overweight or obese upon entering pregnancy (41, 42), pregnancy might be a difficult time in which to intervene through delivery of lifestyle interventions targeting maternal weight. Some authors have recommended minimal weight gain, weight stability or even weight-loss is preferable to achieve optimal pregnancy outcomes in obese women (157, 317, 318). Yet weight-loss during pregnancy remains a contentious issue. The current evidence regarding weight-loss and pregnancy outcomes is limited (318), and some studies have shown adverse outcomes for the foetus as a result of maternal weight-loss, while other studies have shown beneficial effects particularly for obese women (318).

Regardless, the efficacy of interventions which focus on reducing excess GWG delivered during pregnancy are inconclusive and the most effective approaches remain to be determined, despite many interventions having been conducted to date. In contrast, intervention studies which focus on the postpartum period are scarce. Consequently there is a need for innovative, broad reach approaches which aim to address healthy lifestyle behaviours during this phase.

**2.9.2 Interventions aimed at limiting postpartum weight retention**¹

In recent years, a number of intervention strategies have been developed to assist women to lose excess weight gained during pregnancy (319). Yet, overall, interventions targeting PPWR are scarce. Whilst the postpartum period is a time in which women have been found to report higher motivation for weight-loss (14) and has been identified as an ideal phase in which to engage with women in planning weight self-management behaviours (136), success of interventions in limiting PPWR thus far, has been shown to vary (320).

¹ Aspects of this section have been previously published (Appendix 1) (251)

Collectively, interventions which have included both diet and PA components as part of the intervention have been shown to be more effective than those including only one of these components (250-252). Overall, however, interventions which have targeted limiting PPWR, have been varied in their recruitment and assessment of anthropometric outcomes, their intervention components, delivery methods and settings.

**Recruitment**

One challenge in determining an optimal approach to provision of support for women during the postpartum period is identifying the point following childbirth at which interventions should be initiated. There has been noticeable variation in the recruitment stage and commencement of interventions across studies, ranging from between 24 hours following labour (321) up to 12 months postpartum (322). There has also been a distinct absence of rationale for commencing the intervention at different stages, highlighting the need for further investigation into the best time to intervene. However, findings from a recent systematic review of nine postpartum interventions which assessed PPWR and metabolic outcomes (252) highlighted that future interventions should include intervention periods lasting nine months or more, to provide data on longer term outcomes (252), as the majority of studies included in the review lasted approximately three to six months (252).

Many studies to date have recruited overweight or obese women only (270, 320, 323-326), however equally important is the promotion of limiting PPWR, irrespective of a woman’s BMI. As discussed earlier PPWR can increase risk for adverse health complications during the subsequent pregnancy regardless of whether a woman is overweight or not (214, 215). Therefore, future postpartum interventions might aim to recruit women across all BMI groups with the intention of assisting women to return to pre-pregnancy weight.

**Additional anthropometric outcomes**

The majority of postpartum studies to date have not assessed maternal WC measures as part of the anthropometric profile of women. Of those that have, (320, 323, 326-328) results have been mixed. Since overweight and central fat distribution are well established risk factors for morbidity and mortality, assessment of central adiposity following childbirth is highly relevant from a long term public health perspective (218). Future interventions should include
assessment of WC in addition to postpartum weight change, to assist in careful monitoring of risk factors for obesity and related chronic disease such, as CVD.

*Intervention components*

The majority of postpartum interventions that have been successful in reducing PPWR have included both diet and PA intervention components (270, 322, 323, 325-327, 329); a consistent finding identified by three recent systematic reviews (250-252). An exception was a study conducted by Bertz et al (2012). The intervention was successful in promoting weight-loss in the dietary intervention group only, compared to the PA intervention group and the combined diet and PA group (324). That study was unique in providing women with scales for self-monitoring of weight throughout the intervention period (324). Women allocated to the dietary group were instructed to weigh themselves at home three times per week and were contacted via mobile phone text message biweekly to report their body weight. This has been the only study to use text messaging combined with individual counselling as part of the intervention. Leemarkers et al (1998) used telephone support as part of their intervention (322) and Colleran et al (2012) used email support combined with an online dietary program (MyPyramid) (325). Both interventions were successful in achieving postpartum weight-loss. Ostbye et al (2009) included telephone counselling every six weeks as part of their nine month intervention; however there was no significant difference in weight-loss between the intervention and control groups (330).

Few interventions have integrated a theoretical framework in their design, to assist in promoting behavior change (320, 328, 330). However, none of the approaches that have used a theoretical framework to underpin the intervention have been successful in showing differences in weight lost between control and intervention groups. Nonetheless, theory-based interventions have been previously regarded as offering multiple advantages over atheoretical interventions (331) including reduced intervention dosage and increased chance of behaviour change (332). As such, theoretical underpinning is an important consideration in the design of future postpartum interventions.
Intervention delivery

Intervention delivery has been undertaken by a range of health professionals across studies. Nurses have been involved in delivering the interventions on few occasions (328, 329), one of which was successful in promoting postpartum weight-loss (329). Other studies which have showed no significant difference in postpartum weight-loss between the intervention and control groups have been delivered by a certified fitness instructor (333), a trained counsellor (330) and a study assistant (334). Dietitian delivered nutrition counselling has been provided in several studies (270, 320, 324-326), the majority of which have been successful in promoting postpartum weight-loss (270, 324-326). One additional study which showed significant differences in weight-loss between intervention and control groups was delivered by mailed correspondence and by general program staff via telephone (322).

Intervention setting

Interventions that have been successful in promoting postpartum weight-loss have been delivered across a range of settings. Successful interventions have primarily been delivered in the home (323, 325, 327), clinic-based (270, 324, 329) or combined home and clinic-based (322, 326). With women having previously been found to be unwilling to attend weekly group meetings, even when child support was readily available (322), home-based settings might be considered an ideal environment for delivery of healthy weight interventions.

Further, coupled with the provision of home-based support, interventions delivered via mail/post, email, telephone, text messaging or the internet might be even more practical than traditional face-to-face methods. Such modes of delivery for weight-loss support have been successful when implemented as part of interventions in the non-obstetric population (335-337). Those that have employed web-based approaches to delivery are discussed in detail in section 2.10. Specifically, very few interventions to date have actually utilised support via technology-mediated delivery. One study which was successful in promoting weight-loss following a 12 week intervention (324) utilised biweekly text message support. A different study utilised an online dietary tool termed MyPyramid and combined the online component with provision of email support (325). Whilst the focus of that study was to improve dietary intakes in overweight and obese women, the program was effective in promoting weight-loss (325). Interestingly, a recent intervention in Japan, conducted by Tripette et al (2014), incorporated active video games
(AVGs) specifically to overweight and obese women (n=34), which included provision of a Wii Nintendo console with the Wii Fit Plus game for 40 days (323). Women were instructed to play the Wii Fit Plus game each day for 30 minutes. The results showed significantly greater weight reduction in the intervention group (-2.2 ± 0.9kg) compared with the control group (-0.5 ± 0.7kg) (323). In addition, WC measures were significantly improved in the intervention group (-2.9 ± 1.6cm) compared to the control group (-0.8 ± 2.3cm) (323). The authors concluded that despite the use of AVGs in promoting exercise and weight-loss among the general population being under debate, such approaches could represent an interesting opportunity for postpartum women who might have limited time to spend outdoors (323) or outside of their homes.

In summary, the postpartum period presents as an important life stage to influence long term obesity risk as well as maternal weight status for subsequent pregnancies. Despite remaining uncertainties around the ideal approach to provision of support for healthy weight attainment, interventions which have utilised modern technologies have shown some promise in their capacity to limit PPWR. Such strategies which have been effective in the non-obstetric population are outlined below and their capacity to be employed during the postpartum period is discussed.

2.10 Using technology to drive healthy lifestyle and weight-loss interventions

Overall, few studies have assessed technology-driven, cost-effective approaches to postpartum weight management and it behoves us to look beyond the postpartum specific literature in assessing usefulness of such approaches. For example, obesity treatment literature has over recent years increasingly focused on alternative delivery approaches such as telephone counselling and tailored internet weight management interventions (335, 338-340). In reference to successful weight-loss, adults in the general population who receive weight-loss advice from a healthcare professional are more likely to lose weight (340, 341), yet existing programs are challenged by high attrition rates, are resource intensive and have modest scalability (340, 342, 343). In the primary care setting, technology-assisted interventions have been regarded as having the potential to address barriers to provision of care (340) through time and cost savings, improved feedback, enhanced self-monitoring and convenience (340). Furthermore, cost analysis is of fundamental importance in assessing the public health utility of interventions and those that are able to be delivered to large populations might have a more pervasive impact and be more broadly utilised at low cost (344-346).
2.10.1 Web-based health interventions to change behaviour

The internet is being increasingly used to promote behavioural change through the delivery of weight control advice (335, 338, 347). The literature shows that studies utilising web-based interventions for weight-loss in adult populations are increasingly popular and reflect growing interest in and access to these technologies. In 2007 approximately 75% of all adults reported using the internet (348). In Australia, in 2012-2013, 83% of all households had access to the internet, figures which increased from 79% in 2010-2011 (349). This suggests there is great capacity for web-based interventions to reach a large proportion of the population conveniently. Moreover web-based weight management programs have the potential to minimise participation burden associated with group counselling or clinic visits (350, 351) and are therefore a time efficient alternative to traditional face-to-face practitioner contact.

Web-based weight-loss programs have been found to be successful in their delivery as demonstrated by results of systematic reviews of the literature (340, 350, 352, 353), despite there being a relatively small number of studies to date. For example, recently Levine et al (2014) conducted a systematic review of 16 interventions that utilised the internet either via a personal computer or hand-held mobile device, specifically designed to promote weight-loss in primary care settings (340). In total, 12 interventions successfully achieved weight-loss and the review found that compared to usual management, technology-delivered interventions assisted patients in primary care to achieve weight-loss, offering evidenced based support for healthcare providers (340). In an earlier review of weight-loss programs delivered via the internet (352), Weinstein (2006) identified four studies (335, 338, 354, 355) which showed that the interventions were as successful as traditional face-to-face counselling (352) for short term weight-loss. In a more recent systematic review Neve et al (2010) evaluated the effectiveness of web-based interventions on weight-loss and weight maintenance in their systematic review with a meta analyses (339). Despite four out of seven studies being found to be effective based on percentage weight change, they concluded that it was not possible to determine overall effectiveness of the programs in achieving weight-loss or maintenance due to heterogeneity of designs and a small number of studies for comparison (339). Likewise, Arem et al (2011) included nine RCTs in their review, seven of which were included in the review by Neve et al (2010) (339). Arem et al (2011) found that weight-loss results ranged from no loss of weight to -7.6kg (356). The authors summarised that despite definitive conclusions regarding the potential impact of internet delivery for weight-loss interventions
not being possible, future research is required to assess their ability to promote weight-loss or slow weight gain (356).

Web-based intervention studies have differed in their intervention periods, spanning 12 weeks (357), 16 weeks (358), three months (350), six months (335, 359) or one year (360, 361) and effectiveness of the interventions have varied. For example in an Australian sample of overweight and obese men (n=65), Morgan et al (2009) evaluated the efficacy of a three month internet based weight-loss program; the SHED-IT randomised controlled trial (RCT) (350). Men enrolled in the control group received a program booklet and attended an initial information session, also attended by men in the intervention group. Men enrolled in the internet intervention group used the study website to self-monitor diet and PA and receive feedback intermittently throughout the study period. Whilst there was no significant difference found in percentage weight-loss at three months between the intervention group (n=34) and the control group (n=31), the total average weight-loss for the intervention group was significant from baseline to three months (-4.8 kg (95%CI:-6.4, -3.3)) and at six months (-5.3gk (95%CI:-7.3, -3.3). The authors highlighted that a simple weight-loss intervention delivered via the internet can be successful in promoting clinically significant weight-loss in adult men (350).

In an earlier 12 month RCT, Womble et al (2004) found that their intervention which used eDiets, a commercially available weight-loss program, was not effective compared with a written weight-loss manual for achieving weight-loss in obese women (n=47) (360). In fact, women in the group who received written information lost more weight throughout the study. At 16 weeks, weight-loss for the intervention group compared to the control group was (0.9±3.2% of initial weight; 0.7±2.7kg vs 3.6±4.0% of initial weight; 3.0±3.1kg) and at 52 weeks (1.1±4.0% of initial weight; 0.8±3.6kg vs 4.0±5.1% of initial weight; 3.3±4.1kg respectively) (360). In a study assessing weight-loss maintenance, Cussler et al (2008) found that the internet delivered intervention did not surpass self-directedness in being able to maintain weight-loss (361). Following a four month intervention, peri-menopausal women (n=135) were randomly assigned to either a 12 month weight maintenance intervention via the internet (n=66) or a self-directed weight-loss group (n=69). On average, by 12 months, the internet group and self-directed group had regained 0.4±5.0kg and 0.6±4.0kg respectively (361).
On the other hand, results of a study conducted by Bennett et al (2009) (357) showed that women in their intervention group (n=51) achieved weight-loss at three months (-2.28±3.21kg) compared to those in the usual care group (n=50) who on average gained weight (0.28±1.87kg) (mean difference -2.56kg; 95%CI – 3.60, -1.53) (357). However, women in the intervention group also received four counselling sessions, two in-person and two telephone delivered counselling sessions (357) which likely influenced weight-loss outcomes. Face-to-face counselling is unlikely to have real world transferability to large population groups and be time efficient and cost-effective.

Importantly, Khaylis et al (2010) recently conducted a review of efficacious technology-based weight-loss interventions and suggested that for any technology driven weight-loss program, self-monitoring, counsellor feedback, social support, use of a structured program and use of an individually tailored program were crucial to intervention success (362). This has been supported by findings from web-based studies. For example, in a small sample of 50-69 year old rural women (n=21) who were overweight or obese, a three month web-based intervention supplemented with peer-led support, compared to use of a healthy eating and physical activity focused website only (348), was shown to be successful, with large effect sizes being observed over time including weight (0.58lbs) and WC (0.58 inches) (348). Importantly, 93% of the women reported that the supplementary newsletters were ‘very helpful’ in assisting change in eating and increased PA (348). Likewise when comparing two methods of web-based weight-loss intervention delivery, Tate et al (2001) found that in a six month intervention of either internet education or internet behaviour therapy including additional email, self-monitoring diaries, bulletin boards and individual feedback, women in the behaviour therapy group (n=33) lost significantly more weight than women in the education group (n=32) at three months (4.0kg (SD2.8kg) vs 1.7kg (SD2.7kg)) and six months (4.1kg (SD4.5kg vs 1.6kg (SD3.3kg)) and WC reductions were also significantly greater in the behaviour therapy group compared to the education group at three months (6.7cm (SD4.7cm)) vs 3.0cm ((SD4.0cm)) and six months (6.4cm (SD5.5cm)) vs 3.1cm (SD4.4cm)) (335).

In summary, interventions to promote weight-loss have been shown to be useful (348) but further research is needed to determine intervention components that have potential to increase success in producing long term weight-loss (350). Further studies assessing the effectiveness of web-based interventions targeting weight-loss are needed to confirm findings and add to a relatively small available body of literature. Future research is warranted given the potential
of web-based interventions to be a relatively simple method of delivery with wide-reach. Web-based interventions delivered in conjunction with other supportive strategies appear to be a promising approach to weight-loss. Those that offer individual and social support may provide a successful approach for use with first time mothers in the postpartum phase.

2.10.2 Interventions utilising technology during the postpartum period

Web-based weight management programs which offer a feasible strategy and have the potential to be transferable to large populations (347) have not been routinely examined in postpartum populations. Despite there having been mixed views regarding the internet’s overall effect on new mothers (363), in a study conducted in the US (363) McDaniel et al (2012) found that new mothers (n=157) appear to be on the computer approximately three hours per day, with the internet taking up the majority of this time (363). Therefore, web-based interventions might be a highly suitable vessel for delivering supportive health programs to new mothers.

Yet novel approaches to intervention delivery for women in the postpartum are scarce and have mainly targeted provision of telephone support to promote breastfeeding (364-367) and other non-weight-loss related behaviours such as decreasing postpartum depression (365, 368) and assisting in preventing smoking relapse (365, 369). Telephone interventions are considered to have an important place in improving health behaviour outcomes for new mothers (365). For example, Dennis et al (2008) conducted a systematic review of telephone-based support for women during pregnancy and the early postpartum period focusing on promotion of breastfeeding and prevention of postpartum depression (365). Results of the review showed that telephone support, as a primary intervention was beneficial for breastfeeding outcomes (365). The authors suggested that utilising telephone support increases flexibility and cost-effectiveness whilst also promoting individual, person-centred care (365). While the number, length and schedule of telephone calls appears to vary between individuals from one single call to several occasions (365), McBride et al (1999) found that telephone interactions are mostly short, lasting 10 minutes or less (365, 370).

Web-based interventions aimed at facilitating health behaviour change in women during the postpartum period are in their infancy and those that specifically seek to promote weight-loss during the postpartum have seldom been tested. Recently, however, Herring et al (2014) conducted a technology based RCT to promote weight-loss in postpartum, low-income, obese
mothers (n=18) (371) which included online Facebook support combined with telephone support calls and personalised text-messaging. After the 14 week intervention, which commenced at approximately 12 months postpartum, significantly greater weight-loss was observed in the intervention group (-2.9±3.6kg) compared to the control group (0.5±2.3kg) and one-third of women in the intervention group lost > 5% body weight at follow up (371). Although this study was limited to socioeconomically disadvantaged mothers who were of an ethnic minority, the results showed potential for using technology including the internet to deliver postpartum weight-loss interventions (371).

Support for web-based approaches to weight-loss with mothers is provided by Phelan et al (2010), who assessed the degree of self-reported interest in different weight-loss treatment modalities of postpartum women participating in the Women, Infants and Children (WIC) Nutrition program (n=100) and an Adult Education Parenting (AEP) program (n=75) (372). Scores were measured on a 7 point scale (1 = not at all interested; 4 = somewhat interested; 7 = extremely interested) and on average, despite differences in access to a computer, women in both groups showed a similar interest in internet delivered programs for weight-loss (3.5±2.3) (372). The option of an internet based program rated more highly than weekly text messaging (2.4±3.7) and was similar to the interest in weekly telephone support (3.6±2.3) (372) yet an internet based program supplemented with monthly face-to-face visits was most preferred (4.4±2.3). Whilst weekly face-to-face meetings were by far the most preferred form of support (5.2±1.8), around six in ten women in both the WIC program (61%) and AEP (66%) reported needing childcare to attend meetings (372), raising cost and logistical factors as barriers to traditional care. Women included in the analyses were primarily of low socio demographic status, and as such this study provides important insight into how these women might be supported in the postpartum.

Maternal education and household income level have been previously identified as important influences on internet usage among first time mothers (373). These factors are likely to be central when planning novel intervention delivery for this population. An Australian study conducted by Wen et al (2011) used a cross sectional survey with 644 first time mothers participating in the Healthy Beginnings Trial during 2007-2010 to assess who was not likely to access the internet for health information (373). While 37% of women were found not to use the internet for health information, this was socioeconomically patterned with 56% of lower educated compared with 22% of higher educated indicating this to be the case (373). These
findings were replicated when analyses by household income were conducted (373). That study adds to the limited available literature which has assessed first time mothers’ use of the internet, and in particular raises the important consideration of whether additional information or support is needed for women who are less educated or of a lower socioeconomic status. However most mothers in that study reported their own health as being excellent (18%), very good (43%) or good (35%) and as such might not have reason to access web-based health information. Further, a high proportion of the women had a computer in the home (87%) and may have been accessing information which was relevant to them during the postpartum period, other than generic health information. For some women, this may have included weight-loss advice, however this was not assessed in the study.

Walker et al (2012) more recently assessed postpartum women’s access, perceived skill, confidence and internet and mobile technology use via mail-out surveys in a random sample of 145 mixed race, socioeconomically diverse women in Texas (374). The study focussed on weight related health information sought by women from approximately 5-10 months postpartum and data were part of a larger survey of 600 women. Similar to the results of Wen’s Australian study (2011), 84% of the sample in this study had home access to a computer with internet connection (374). In addition, 85% of women rated themselves as “very confident” regarding logging on to a website needing a username and password and 79% rated their skill level as high in being able to connect to the internet (374). In terms of preferred weight-loss advice, 36% of the total sample of women reported “a lot” of interest in an internet delivered weight-loss program compared with 39% in program sent via mail (374). Women of higher incomes were more likely to report “a lot” of interest in receiving information via the internet (374) however reasons for preferences were not discussed and may or may not have necessarily been related to the factors explored (e.g. access or rated skill level).

Whilst assessment of web-based interventions to promote postpartum weight-loss is in its infancy, such approaches to intervention delivery might offer highly suitable and flexible methods of engaging new mothers. Postpartum interventions which utilise the internet may present a promising alternative to weight-loss interventions conducted to date. The review of literature has, in part, provided a springboard for the design, development and implementation of the postpartum intervention outlined in chapters 5 and 6 of this thesis. Given the importance of ensuring women are well supported to achieve healthy weight gain during pregnancy and
minimise the weight retained following childbirth, it is necessary to gain further insight into how such support might be best delivered.

2.11 Conclusion and thesis aims

This literature review has highlighted some major gaps in the current evidence base. Firstly, documenting the experiences of healthcare providers in their management of GWG is needed to assist in identifying existing barriers to support and determine opportunities for future support. General practitioners participating in shared antenatal care have frequent contact with women throughout their pregnancies. As such, their perspectives on managing GWG are highly relevant and could help inform future antenatal practice.

From a woman’s perspective, the advice received during pregnancy and in the postpartum from a variety of healthcare providers will inform understanding of the provision of management surrounding healthy weight attainment and healthy lifestyle behaviours. Studies which focus on women’s reported advice delivered during periods of expected weight gain are limited. In Australia, there is very little literature available, making it difficult to draw conclusions about current provision of care although some studies having suggested inconsistencies in approaches to provision of advice.

Also scarce are behavioural interventions which focus on healthy maternal weight and promotion of healthy lifestyle behaviours. In particular, few studies have aimed to limit PPWR. The postpartum phase has been identified as an ideal period, yet missed opportunity, to engage with women for the purpose of promoting healthy weight. Motivation during the postpartum period has been suggested to be higher than during pregnancy and as scheduled contact with healthcare providers occurs far less than during pregnancy, provision of support during the postpartum period may be particularly important.

Supporting women to achieve a healthy body weight and healthy lifestyle behaviours across the perinatal period is vital to reduce risk for adverse health outcomes during subsequent pregnancies and risk of future obesity and related morbidity. Interventions should be responsive to the unique lifestyle of a new mother and delivery should be straightforward with high transferability. Therefore, novel approaches to healthy weight attainment during the
postpartum period, particularly those utilising modern technologies for their delivery, are appealing avenues for healthy weight and healthy lifestyle support. Broadly, the aim of this PhD is to document current management of GWG and PPWR and identify opportunities to best support first time mothers in their attainment of a healthy weight status and adoption of healthy lifestyle behaviours.

The specific aims of the PhD are to:

1. Critically review the literature regarding maternal weight gain and provision of weight related support during pregnancy and following childbirth

2. Investigate the views, perspectives and perceived barriers of GPs involved in shared antenatal care regarding GWG management

3. Describe the advice received by mothers across the perinatal period from healthcare providers regarding weight, diet and PA and assess the influence of advice on maternal weight and healthy lifestyle behaviours

4. Design and implement a postpartum pilot intervention study with first time mothers to promote healthy maternal weight, diet and PA habits and reduce sedentary behaviour

5. Investigate the perceived feasibility, satisfaction and involvement of first time mothers who completed the postpartum intervention study and make recommendations for future research
Chapter 3

Opportunities for primary and secondary prevention of excess gestational weight gain: Views of general practitioners regarding gestational weight gain assessment and management

3.1 Introduction

The previous chapter provided rationale for the clinical assessment of GWG, in the interest of best maternal and child health outcomes. However, few studies have examined the views of antenatal healthcare professionals regarding gestational weight management and impact (279). It is necessary to explore this to identify how practitioners themselves might be best supported to ensure women are given the best chance to achieve healthy GWG. As such, this chapter reports the methodology and results from the first study of this thesis, a qualitative study assessing the views of GPs regarding GWG assessment and management. A discussion of the main barriers to provision of support is presented, with recommendations for future supportive strategies provided.

As discussed in Chapter 2 (2.2.2), the prevalence of overweight and obesity are increasing among women of childbearing age (375), mirroring rising rates of these conditions in the general population. In the Australian context, recent data has shown that almost 50% of women are entering pregnancy already overweight or obese (41, 42), similar to rates in the US (376). For women who begin their pregnancy at a BMI higher than the normal range, evidence suggests that excess GWG is more common than for women who are a healthy weight when becoming pregnant (83, 96, 377). This is of particular concern as there appears to be a higher risk for adverse pregnancy outcomes when excess GWG is combined with high pre-pregnancy maternal BMI.

² Aspects of this chapter have previously been published (Appendix 2) (378).

Whilst mean GWG has increased in developed countries over recent decades (155, 379) and the health consequences of excess weight gain has received increased attention, there are currently no Australian recommendations for GWG. However, in the US the 2009 IOM recommendations (67, 69) provide clinical guidance as to the appropriate amount of weight women should gain during their pregnancies. The 2009 IOM guidelines were presented in Chapter 2 (2.4.2) (Table 2.3).

Epidemiological data has provided a strong rationale for these guidelines whereby women who gain within the IOM recommendations have been found to have better perinatal outcomes that women who exceed them (277). Yet an estimated 40-50% of women gain above the IOM recommendations (380-382), which may suggest that mere presence of guidelines per se may not be sufficient to promote healthy GWG at a population level. Assessment of how the guidelines are both implemented and communicated is a key consideration.

As discussed in Chapter 2 (2.5), irrespective of pre-pregnancy BMI, excess weight gain during pregnancy places both mother and child at increased risk of serious health complications (96, 300, 383, 384). However, to date, weight management during pregnancy has not been emphasised in the prenatal care of expectant mothers (385). Of concern is that many women no longer cite their healthcare provider as their main source of weight related information (386) and many clinicians do not provide weight counselling as part of routine practice (387). Pregnancy might therefore be considered a missed opportunity for supporting women in their attainment of healthy gestational weight. Understanding how and why healthcare providers might incorporate management of GWG into their antenatal care is important in maximising prevention of excess GWG during this opportune period.

Whilst the delivery of prenatal care will differ across countries, a number of health professionals, including physicians, midwives and obstetricians frequently deliver such services throughout pregnancy (277). In Australia, women often choose to have their antenatal care shared between their GP and obstetrician. This approach is known as ‘shared care’. With many occasions to engage women at this time, clear opportunities to support women to achieve positive lifestyle changes that may promote healthy GWGs exist. While these healthcare providers are likely to be central in promoting such changes, little is known about the ways in which such professionals engage with these issues across pregnancy (388).
General Practitioners have been identified as important contributors to the treatment of overweight and obesity in the non-pregnant population (389, 390) and represent 42% of the medical workforce in Australia (391). Elsewhere, GPs have been described as “gatekeepers to the health system”, with the opportunity to play a key role in addressing obesity within consultations (392). Findings from an Australian study assessing weight management practices provided by GPs across five different metropolitan and rural general practices showed that of 227 patients, 80% reported being likely to follow weight loss recommendations and 78% felt that GPs had a role in weight management (393). Moreover, provision of advice from primary care practitioners incorporating weight gain targets has been found to be an effective strategy in weight management in the non-pregnant population (394). Potter et al (394) surveyed 366 adult patients from two primary care practices and found that one of the components the patients reported wanting most to help them achieve successful weight loss was physician help in setting realistic weight goals.

Given that pregnant women see a healthcare provider frequently, (277) early support for healthy GWG is feasible. The first antenatal visit is often to the GP (395) and hence GPs may have a key opportunity to influence GWG. General Practitioners specifically participating in shared antenatal care have frequent contact with women throughout their pregnancies and offer specialised obstetric care up until the labour. As such, their perspectives on managing GWG are highly relevant and may help to inform future antenatal practice. Importantly, no studies to date have focused specifically on GPs’ perspectives regarding prevention of excess GWG. Understanding the ways in which GPs currently view and manage GWG is fundamental to help identify options for better provision of support in the interest of best weight related maternal and child health outcomes.

### 3.2 Aims

This study sought to assess GPs’ perspectives regarding the assessment and management of GWG and to understand how GPs can be best supported to provide healthy GWG advice to pregnant women. Therefore, the aims of this study were to:

- document the experience of GPs in the assessment and management of women entering pregnancy already overweight;
• assess GPs’ perceived role in the promotion of healthy GWG more broadly;
• understand GPs’ views regarding the ways in which they may be supported to promote healthy GWG

3.3 Methods

3.3.1 Recruitment and data collection

In this study, purposive sampling across a rural and a city sample was used for participant selection. This allowed the selection of relatively small (396) information rich cases and maximised breadth of experience across localities. Nevertheless, in quantitative studies generalisability is achieved via statistical sampling procedure. However such sampling procedures are mostly unavailable in qualitative studies (397), with wide scale generalisability not an aim of qualitative research.

General Practitioners in Geelong, Victoria, participating in shared antenatal care were identified by telephoning all medical practices from a practitioner list provided by the GP Association of Geelong. In Sydney, two divisions of general practice were contacted from which a list of GPs participating in shared antenatal care was obtained. General Practitioners were approached in these two areas as the Geelong GP community was easily accessible to the university institution where this study was undertaken, and GPs located in Sydney were easily accessible by colleagues located in surrounding areas. All GPs identified as being antenatal shared care providers in the Geelong, Victoria region by the GP Association of Geelong (n = 175) along with a randomly selected sample of 131 Sydney GPs from the Central Sydney GP Network providing shared care (out of a possible 489), were invited by personal letter to participate in the study. All GPs who replied to the invitation (n=32) were telephoned and an interview time was scheduled either via telephone (Sydney GPs) or face-to-face (Geelong GPs). Telephone interviews were scheduled for GPs in Sydney due to limited PhD funding for interstate travel to conduct face-to-face interviews. Participants were provided with a plain language statement and consent form either via email or post and all participants provided written, informed consent to participate and have the interview digitally recorded. Consent forms were collected via facsimile from each GP clinic on the day of the interview prior to the interview. Participating practitioners were reimbursed with a store voucher to the value of one hundred dollars as compensation for their time. Ethics approval for this study was obtained
from Deakin University and the University of New South Wales Human Research Ethics Committees.

A descriptive qualitative approach was used in this study to understand the views of GPs regarding their management of excess GWG. Methods of qualitative description as described by Sandelowski (398, 399) were employed. Key design features of qualitative description include maximum variation in sampling, data collection through interviews and qualitative analysis. It also offers a descriptive validity of the situation, that is, an accurate accounting of the events that most people observing the event would agree is accurate. Specifically, qualitative research techniques have been commonly advocated as suitable for research on and within some general practice (400) settings.

Overall, qualitative interviews provide a flexible approach enabling a probing assessment of a topic. This approach seeks to uncover ideas or concepts that may not have been anticipated at the outset of the research (401). All interviews were organised at a time convenient to the GP to best accommodate time pressures commonly faced by healthcare practitioners (402). Semi-structured interviews were used for this study. A semi-structured format has the benefit of involving a set of open-ended questions which allow for spontaneous and detailed responses (403, 404). Typically, broad and guiding questions tend to solicit detailed responses (404) and are often supported with prompts that encourage the participant to elaborate upon an answer or be redirected back to the main topic should they become side tracked (403, 404). The interview questions employed in this study are outlined in Table 3.1.

3.3.2 Data analysis

All interviews were transcribed verbatim by an online transcribing company. Thematic analysis was used to assess repeated practices and perspectives across all data. Thematic analysis has previously been described as an effective tool for providing rich and detailed qualitative data (405). The data were analysed firstly by six randomly selected transcripts being read and analysed independently by two researchers to ensure that coding and identification of emerging themes was consistent. One researcher was the PhD candidate and the other was a research assistant with prior experience conducting and analysing qualitative research (JW).
<table>
<thead>
<tr>
<th>Question</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. How many pregnant women would you see on average per year?</td>
</tr>
<tr>
<td>2. In your view, what are the 3-5 most important things you think should be covered in a (the first) consultation with a pregnant woman?</td>
</tr>
<tr>
<td>3. (a) At what point in the pregnancy do women generally present to primary care practitioners?</td>
</tr>
<tr>
<td>(b) And what about subsequent consultations?</td>
</tr>
<tr>
<td>4. How many consultations would there usually be and what is the focus of subsequent consultations?</td>
</tr>
<tr>
<td>5. (a) How often are women weighed throughout their pregnancies?</td>
</tr>
<tr>
<td>(b) Is BMI at first presentation calculated?</td>
</tr>
<tr>
<td>(c) Is weight trajectory plotted?</td>
</tr>
<tr>
<td>6. (a) Is advice regarding anticipated gestational weight gain offered?</td>
</tr>
<tr>
<td>(b) If no, is there a reason for this?</td>
</tr>
<tr>
<td>(c) Does this take into account BMI at commencement of pregnancy?</td>
</tr>
<tr>
<td>7. If a woman is overweight at first presentation, are you more likely to assess, advise and/or refer for weight management or healthy eating or physical activity education? How would this be done?</td>
</tr>
<tr>
<td>8. What are the triggers that alert you to excess gestational weight gain and increased risk?</td>
</tr>
<tr>
<td>9. In your mind, what do you consider to be the most important implications of overweight and obesity in pregnancy and of weight gain in excess of recommendations?</td>
</tr>
<tr>
<td>10. Do you undertake any assessment of lifestyle behaviours? If so, which lifestyle behaviours do you assess?</td>
</tr>
<tr>
<td>11. (a) In a perfect scenario, how do you imagine you would be best supported to provide healthy lifestyle advice and support to pregnant women?</td>
</tr>
<tr>
<td>(b) Do you think that support via the internet, mail or telephone would be useful for weight management advice or healthy lifestyle advice in supporting both yourself and also the pregnant woman?</td>
</tr>
<tr>
<td>12. What sort of information do women mostly seek about their pregnancy and does this ever include weight gain advice?</td>
</tr>
<tr>
<td>13. (a) Is there much/any interaction with other members of the antenatal team within the practice (such as nurses) regarding weight monitoring or management?</td>
</tr>
<tr>
<td>(b) If so, how does this happen?</td>
</tr>
</tbody>
</table>

Analysis of the 14 Sydney transcripts was undertaken by a separate researcher (the primary supervisor of the PhD candidate), and the remaining 14 Geelong transcriptions were analysed by JW. All transcriptions were then re-analysed by the candidate to ensure consistency. Interview responses made by the GPs were grouped into categories relating to their content. For example, time for first appointment, reasons/thoughts on weighing and not weighing, weight gain advice, referrals, barriers to weighing, support, health consequences etc. Anonymity of participants was maintained through the use of de-identified data.
3.4 Results

3.4.1 Participants

A total of 32 GPs responded to the invitation letter. Thirty GPs scheduled an interview, however two were not available at the time of the scheduled telephone interview and therefore did not participate. Twenty eight GPs took part in the interviews; 14 from Geelong and 14 from Sydney. They were drawn from 22 different clinics within the Greater City of Geelong and metropolitan Sydney. The practices represented a range of socio demographic regions. No GPs withdrew from the study and data from all 28 interviews were included in the analyses. Data saturation, that is, when the interview responses have effectively addressed all aspects of the resulting themes and phenomenon with optimal data quality (406) had occurred by this stage; hence there was no need to recruit additional participants.

3.4.2 Themes

Participant responses clustered into five broad themes:

(i) GPs’ own awareness of the issues and identifiable problems of overweight and obesity and excess weight gain;
(ii) Provision of advice regarding GWG and healthy lifestyle behaviour;
(iii) Attitudes and practices around routine gestational weighing;
(iv) Practical barriers to management;
(v) How GPs feel they could be best supported

Quotes which best represented GPs’ views and supported these five broad themes are presented in Table 3.2.
Table 3.2 Summary of themes with supporting verbatim quotes

<table>
<thead>
<tr>
<th>Themes and verbatim quotes</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>(i) GPs’ own awareness of the issues and identifiable problems of overweight and obesity and excess weight gain</strong></td>
<td></td>
</tr>
<tr>
<td>“But certainly weight is important, and mostly because of gestational diabetes. Really because that impacts on the mother and the baby, and the whole birth outcome (GP005)”</td>
<td></td>
</tr>
<tr>
<td>“Well, gestational diabetes definitely. Possibly pregnancy induced hypertension. And also just complications with delivery because like if, for example they need to have a caesarean, I mean that’s going to be really difficult if they’re really obese, so, yes, sort of delivery complications as well (GP026)”</td>
<td></td>
</tr>
<tr>
<td>“Weighing pregnant women is actually very useful when it comes to pre-eclampsia (GP003)”</td>
<td></td>
</tr>
<tr>
<td>“You know, they are going to be a huge sitting duck for postnatal depression (GP020)”</td>
<td></td>
</tr>
<tr>
<td>“And then there’s obviously the flow on effects for the baby as well, the baby’s health (GP020)”</td>
<td></td>
</tr>
<tr>
<td>“Well yes there is evidence that it affects the foetus and the wellbeing of the child in future life (GP016)”</td>
<td></td>
</tr>
<tr>
<td>“So I do normally tell the overweight woman about the implication of the long term health problem, plus the implication for young children, because whatever you’re doing, your children will be doing the same (GP018)”</td>
<td></td>
</tr>
<tr>
<td>“But obviously children will be obese if mum puts on weight, and keeps going putting on weight or something (GP017)”</td>
<td></td>
</tr>
<tr>
<td><strong>(ii) Provision of advice regarding GWG and healthy lifestyle behaviour</strong></td>
<td></td>
</tr>
<tr>
<td>“Actually I’m not quite sure how much is too much. Well certainly gaining to...like 20 kg, that’s probably too much (GP019)”</td>
<td></td>
</tr>
<tr>
<td>“I mean we used to work on the sort of one and a half kilograms a month was acceptable. But then when you’ve got people that are perhaps overweight or obese to start with, we always tried to keep their weight gain at a lot less than that (GP006)”</td>
<td></td>
</tr>
<tr>
<td>“I certainly explain to the women that they should only be putting on between 10 and 14kg for the pregnancy (GP008)”</td>
<td></td>
</tr>
<tr>
<td>“If they ask, I normally say advisable weight gain is about 12-13kg (GP018)”</td>
<td></td>
</tr>
</tbody>
</table>
"I think that women will bring it (weight) up of their own accord if they've got concerns about it (GP004)"

"No, I usually don't (take into account pre-pregnancy BMI), even if it's applicable. I'm not trained to do that and I'm not aware of any protocol guiding me towards that (GP017)"

"Only that they do not need to eat for two (GP005)"

"...there's a feeling that exercise during pregnancy may be harmful, particularly in early pregnancy, and to encourage them to keep exercising, I think, is also helpful (GP006)"

"Actually, when women are pregnant, they're actually very receptive to lifestyle and healthy lifestyle advice (GP012)"

(iii) Attitudes and practices around routine gestational weighing

"So I think that weight wasn't a good indicator of maternal or foetal wellbeing, so I think it fell out of favour (GP005)"

"I noticed that on the shared care antenatal chart established by the hospital the column for weight has disappeared (GP006)"

"...we have been advised in the last few years not to weight them, and they actually don't weight them in the hospital clinic either (GP016)"

"I'm not sure what the reason why not weighing (GP008)"

"Weighing (as standard practice) is coming back (GP005)(GP007)(GP010)"

"...because they don't get weighed any longer, it is no longer an issue for them (GP014)"

"So the focus generally turns off themselves and onto the baby. And sometimes they're seeking advice about their weight but not a lot (GP020)"

(iv) Practical barriers to management

"I think time is the most significant thing because (I) always have to rush to see patients (GP019)"

"There is a lot to cover (in the initial consultation), and that's just it really, a lot of it is just the practicalities (GP004)"

"Space, time, funding, who's going to organise it? So all the organisational and implementation issues (GP019)"

"But in terms of weight gain, like what to eat and what not to eat for fat and all that, I don't go into too much detail because it's too time consuming. I don't have time (GP018)"

"Just cost and waiting times, and all that sort of stuff too (GP004)"
How GPs feel they could be best supported

“Cost - most dietitians charge a dietitian fee (GP006)”

(4) How GPs feel they could be best supported

“So, I guess from my point of view it’s not just what the doctor says, it’s what other health professionals can offer, and motivation (GP010)”

“If there was a dietitian attached to this clinic that would be readily available, that would be marvellous, because any woman who I even eyeball to be overweight and therefore at risk of gestational diabetes, I would refer most of my women to this dietitian (GP005)”

“…so having access to either a dietitian or an exercise physiologist, or both, that we’d be able to send people to would be good (GP028)”

“Look, it’d be great if every new pregnant woman coming here had access to a dietitian and/or exercise physiologist, if they had an appointment already set up with each of those every time they come in. And I mean that would be wonderful if that was just part of routine, or even if that was part of the routine at the hospital - and that’s probably an even bigger ask (GP020)”

“And so you know that people don’t remember a lot about a consultation, and so like I say, some written information I think is always good (GP004)”

“I think that would be a really helpful thing if it was on different aspects of the pregnancy. Because mail-outs or emails, I think that pregnant women are very - they’re very centred on doing everything right (GP011)”

“But if they have a support network inside the antenatal clinic on the first or second visit, then they get a group session of people talking about the…this is the expected weight, and exercise and all that, in a group session, I think that would be very beneficial (GP018)”

“You know that Medicare gives us 5 referrals to a dietitian in the one year if they qualify for the care plan? But they have told us that pregnancy is not a sickness (GP015)”
Theme (i) GPs’ own awareness of the issues and identifiable problems of overweight and obesity and excess weight gain

General Practitioners identified that excess GWG and gestational overweight and obesity adversely affect both the mother and child and the majority of GPs reported that gestational diabetes was one of the most important implications of excess GWG, overweight or obesity in pregnancy. For example “But certainly weight is important, and mostly because of gestational diabetes. Really because that impacts on the mother and the baby, and the whole birth outcome (GP005)” and “Well, gestational diabetes definitely. Possibly pregnancy induced hypertension. And also just complications with delivery because like if, for example they need to have a caesarean, I mean that’s going to be really difficult if they’re really obese, so, yes, sort of delivery complications as well (GP026)”. General Practitioners frequently identified pre-eclampsia, hypertension and delivery complications as major implications of excess GWG and maternal overweight and obesity. One GP acknowledged the importance of weighing women for the purpose of identifying pre-eclampsia by stating “Weighing pregnant women is actually very useful when it comes to pre-eclampsia (GP003)”. Other adverse complications identified infrequently included higher rates of miscarriage, increased rates of unplanned caesarean section, general unspecified obstetric complications, maternal morbidity or mortality, conditions of fatigue, high cholesterol, decreased cardiac fitness, postnatal depression and chronic diseases later in life. One GP linked excess GWG with postnatal depression by stating “You know, they are going to be a huge sitting duck for postnatal depression (GP020)”.

General Practitioners recognised varied child health outcomes associated with excess GWG and maternal overweight and obesity including macrosomia, foetal abnormalities and a reduced ability of the practitioner to palpate and examine the baby, thus placing the child at higher risk of undetected abnormalities. Responses from three GPs were “And then there’s obviously the flow on effects for the baby as well, the baby’s health (GP020)” and “Well yes there is evidence that it affects the foetus and the wellbeing of the child in future life (GP016)” and “So I do normally tell the overweight woman about the implication of the long term health problem, plus the implication for young children, because whatever you’re doing, your children will be doing the same (GP018)”. Interestingly, few GPs directly identified child overweight or obesity in the long term as being amongst the most important identifiable problems, but one
GP stated “But obviously children will be obese if mum puts on weight, and keeps going putting on weight or something (GP017)”. 

**Theme (ii) Provision of advice regarding GWG and healthy lifestyle behaviour**

Overall, the advice regarding recommended GWG was inconsistent. Recommendations regarding appropriate weight gain in pregnancy ranged from 8 kg to 15 kg for normal weight women. There were varied responses which included “Actually I’m not quite sure how much is too much. Well certainly gaining to...like 20 kg, that’s probably too much (GP019)”, “I mean we used to work on the sort of one and a half kilograms a month was acceptable. But then when you’ve got people that are perhaps overweight or obese to start with, we always tried to keep their weight gain at a lot less than that (GP006)”, “I certainly explain to the women that they should only be putting on between 10 and 14kg for the pregnancy (GP008)” and “If they ask, I normally say advisable weight gain is about 12-13kg (GP018)”. A small number of GPs offered no weight gain advice or offered advice only when asked by the women. One GP reported “I think that women will bring it (weight) up of their own accord if they’ve got concerns about it (GP004)”. Furthermore, GPs rarely took BMI into account at the beginning of pregnancy when offering advice. One GP stated “No, I usually don’t (take into account pre-pregnancy BMI), even if it’s applicable. I’m not trained to do that and I’m not aware of any protocol guiding me towards that (GP017)”. In addition, GPs rarely reported that gestational weight would be among the most important issues to be discussed at the first appointment.

Other than specific nutrient advice and nutrition recommendations for pregnancy, GPs rarely considered general healthy eating advice among the most important topics that should be covered in the initial consultation with the pregnant woman. When provided, if at all, the advice was non-specific. For example “Only that they do not need to eat for two (GP005)”. They infrequently provided exercise advice during pregnancy (in the absence of general healthy eating advice) or mentioned that both general healthy eating advice as well as exercise advice should be given in the first consultation. One GP acknowledged that women often perceived exercise to be somewhat harmful or dangerous during pregnancy, but that provision of exercise advice was important. The GP stated “…there’s a feeling that exercise during pregnancy may be harmful, particularly in early pregnancy, and to encourage them to keep exercising, I think, is also helpful (GP006)”. Another GP reported that women were receptive to receiving such
advice during their pregnancies by stating “Actually, when women are pregnant, they’re actually very receptive to lifestyle and healthy lifestyle advice (GP012)”.

Theme (iii) Attitudes and practices around routine gestational weighing

Attitudes towards weighing varied. There was a clear division in comments provided by the GPs for and against weighing, highlighting a distinct division of opinion surrounding the usefulness and appropriateness of weighing. Most GPs weighed women occasionally throughout their pregnancies. Only a small proportion of GPs weighed women at every visit. There were different reasons given for not weighing women. Some GPs were influenced by hospital antenatal protocols whereby several GPs reported that the antenatal clinic had advised against weighing women during pregnancy. For example “So I think that weight wasn’t a good indicator of maternal or foetal wellbeing, so I think it fell out of favour (GP005)” and “I noticed that on the shared care antenatal chart established by the hospital the column for weight has disappeared (GP006)” and “…we have been advised in the last few years not to weight them, and they actually don’t weigh them in the hospital clinic either (GP016)”. One GP was uncertain about reasons why weighing was not standard practice, reporting “I'm not sure what the reason why not weighing (GP008)”.

Many GPs agreed that despite weighing not being emphasised as part of routine practice, it was slowly re-emerging as an issue of importance in clinical management. For example “Weighing (as standard practice) is coming back (GP005) (GP007) (GP010)”.

A small proportion of GPs agreed that despite weighing not being emphasised as part of routine practice, it was slowly re-emerging as an issue of importance in clinical management. For example “Weighing (as standard practice) is coming back (GP005) (GP007) (GP010)”.

Many GPs considered weighing to be time consuming and were therefore reluctant to incorporate this into their consultations. In addition, there was wide variation in reported information pregnant women seek during their pregnancy with regard to weight. Some GPs reported that women were interested in seeking weight gain information whereas others reported that women did not ask about how much weight they should be gaining during pregnancy. One GP stated “…because they don’t get weighed any longer, it is no longer an issue for them (GP014)”.

A different GP said “So the focus generally turns off themselves and onto the baby. And sometimes they’re seeking advice about their weight but not a lot (GP020)”.
Theme (iv) Practical barriers to management

When GPs were asked about barriers that prevent provision of support to provide healthy lifestyle advice and manage GWG, responses were mixed. Lack of GP time and short consultation periods, as well as lack of organisational structure within the practice including extensive patient waiting lists were commonly reported barriers to management. One GP stated “I think time is the most significant thing because (I) always have to rush to see patients (GP019)”. Other GPs said “There is a lot to cover (in the initial consultation), and that’s just it really, a lot of it is just the practicalities (GP004)”, “Space, time, funding, who’s going to organise it? So all the organisational and implementation issues (GP019)” and “But in terms of weight gain, like what to eat and what not to eat for fat and all that, I don’t go into too much detail because it’s too time consuming. I don’t have time (GP018)”.

Approximately one third of GPs mentioned financial cost to the patient as a barrier to provision of additional support. One GP reported “Just cost and waiting times, and all that sort of stuff too (GP004)”. A different GP said “Cost - most dietitians charge a dietitian fee (GP006)”. Few GPs reported cost as a barrier to hire additional clinicians at the medical practice. Other barriers mentioned included a lack of space and resources for additional practitioners at the clinic, specifically dietitians or practice nurses. A small proportion of GPs also reported difficulty with community referrals to healthcare providers outside of their own practice, in that community health centres usually had long wait lists for patients seeking weight advice. A few of the GPs reported reliance on women being sent to the hospital diabetes clinic should weight management be sought and therefore felt that further GP support was not required.

Theme (v) How GPs feel they could be best supported

The majority of GPs interviewed reported being more likely to assess, advise and/or refer for weight management to other healthcare providers if the woman was overweight at first presentation. Many GPs reported that multidisciplinary support and input from other healthcare providers would help them feel best supported. One GP said “So, I guess from my point of view it’s not just what the doctor says, it’s what other health professionals can offer, and motivation (GP010)”. Most GPs reported that dietitian support would be preferred. For example “If there was a dietitian attached to this clinic that would be readily available, that would be marvellous, because any woman who I even eyeball to be overweight and therefore at risk of gestational...
diabetes, I would talk to them about healthy eating in pregnancy and risk of gestational diabetes, and I refer most of my women to this dietitian (GP005)” and “...so having access to either a dietitian or an exercise physiologist, or both, that we’d be able to send people to would be good (GP028)”. They felt that having a formal program in place within the clinic, which included nutrition and exercise lifestyle management, would benefit women early in their pregnancy. Some GPs suggested support from exercise physiologists, diabetes educators, endocrinologists or midwives would be the preferred support. One GP said “Look, it’d be great if every new pregnant woman coming here had access to a dietitian and / or exercise physiologist, if they had an appointment already set up with each of those every time they come in. And I mean that would be wonderful if that was just part of routine, or even if that was part of the routine at the hospital-and that’s probably an even bigger ask (GP020)”.

Few GPs reported that support provided to women via the internet or written resources to reiterate their own advice would be preferred support. Regarding written material, one GP stated “And so you know that people don’t remember a lot about a consultation, and so like I say, some written information I think is always good (GP004)”. In support of the internet to provide information, a different GP said “I think that would be a really helpful thing if it was on different aspects of the pregnancy. Because mail-outs or emails, I think that pregnant women are very - they’re very centred on doing everything right (GP011)”.

When asked specifically whether they thought these avenues of information would be useful in helping convey healthy eating and activity advice assisting weight management and providing support to the practitioner and also the pregnant woman herself, most GPs thought that at least one of these forms of education would be helpful. In particular, one GP was in favour of group based education, reporting “But if they have a support network inside the antenatal clinic on the first or second visit, then they get a group session of people talking about the...this is the expected weight, and exercise and all that, in a group session, I think that would be very beneficial (GP018)”.

One GP mentioned that provision of the Australian government funded Medicare Enhanced Primary Care (EPC) referral program, to dietitians, for patients requiring weight management, didn’t apply to women who were pregnant. The GP felt this would be a useful management tool to support women in their attainment of a healthy gestational weight but that the regime did not apply to weight management during pregnancy, because the pregnancy life stage was
not regarded as being a ‘sickness’. The GP stated “You know that Medicare gives us 5 referrals to a dietitian in the one year if they qualify for the care plan? But they have told us that pregnancy is not a sickness (GP015)".

3.5 Discussion

This study aimed to examine the perspectives of GPs participating in shared antenatal care regarding GWG and to understand opportunities for primary and secondary prevention of excess GWG. This is the first study to investigate how GPs feel they would be best supported to provide healthy lifestyle advice to pregnant women and healthy maternal weight management. The GPs in this study had mixed views regarding the management and prevention of excess GWG, demonstrated by their varied weight gain recommendations, weighing practices and views regarding maternal and child health complications associated with excess GWG.

Antenatal care has previously been described as an opportune time for healthcare providers to assist women in altering lifestyle affecting weight, nutrition and physical activity (277). In a recent US study, obstetricians and midwives reported that weight gain management during pregnancy was not a high priority (385), yet they regarded diet and exercise as important and most “tried their best” to utilise these topics as part of their management approach (385). Given that pregnant women are highly motivated to achieve the best outcomes for their child (407), GP advice regarding lifestyle behaviours would be a particularly important component of shared antenatal care. In this study, very few GPs offered both general healthy eating and exercise advice as part of the first consultation. They reported that a multidisciplinary approach utilising input from allied health professionals would provide the most useful support. Referral to a dietitian for healthy lifestyle advice and weight management was frequently suggested as the preferred approach. However, the GPs interviewed identified multiple barriers to the provision of additional health practitioners input, including increased cost to the patient, the medical practice itself and to the health system, lack of physical capacity within the medical practice to employ additional healthcare providers and lack of organisational structure required for additional consulting.

This study suggests that GPs feel uncertain regarding the need to or even the desirability of weighing pregnant women in GP consultations. Over a third of GPs in this study either did not
weigh at all or weighed women only when women asked to be weighed. These results are perhaps not surprising when observing findings from other studies. For example, in a recent Australian study, Knight-Agarwal et al (2013) conducted a series of focus groups with midwives and obstetricians to assess their views and attitudes in providing antenatal care to women with a high BMI (377). Both midwives and obstetricians in that study reported that weight is no longer routinely collected at antenatal visits (377) and that weighing women to simply identify if they are obese would be a waste of time (377). In an earlier study of 103 hospital antenatal healthcare providers, also conducted in Australia, 81% of staff reported weighing women either at booking only, or never (408). Furthermore, approximately half of the 49 obstetricians surveyed reported that they did not weigh pregnant women at all (408).

The barriers to weighing women during pregnancy identified in this study were time constraints and uncertainty regarding weight gain advice. Similar findings are reported by Olander et al (279), where focus groups and interviews were used to assess healthcare providers’ (midwives, social workers and antenatal care centre managers) views regarding GWG (279). Time limitations and lack of knowledge regarding GWG, and not weighing women during consultations, were identified as limitations to provision of care (279). Likewise, lack of knowledge and lack of educational materials have been found to be barriers to provision of weight management in the primary care setting (255).

The absence of weight gain advice provided by GPs in this study is perhaps not surprising. In Australia there are no formal recommendations for GWG. The inconsistency in approach regarding GWG advice in this study reflects findings from a Dutch study (228) where advice received by 144 pregnant women was assessed. In that study, 12% of participants reported receiving no advice for weight gain from their healthcare provider, 23% received weight gain advice that was higher than IOM recommendations and 5% received advice that was below recommendations (228). Further, the majority of women who were overweight or obese pre-pregnancy were advised to gain weight in excess of IOM recommendations (228). In a more recent qualitative study, Stengel et al (2012) found overweight and obese women rarely received advice about how much weight to gain during pregnancy. When advice was provided it was frequently inconsistent with guidelines, whereby these women were recommended to gain what would be expected for a women with a normal BMI (409). Those findings are consistent with those of an earlier study whereby only 64% of 900 obstetricians modified their GWG advice based on pre-pregnancy BMI (409, 410).
Interestingly in the current study, when weight gain advice was given it varied widely. This is consistent with findings from other studies (256, 277, 279, 299, 377). Importantly, however, when women receive GWG advice from their doctor (387, 411) or obstetrician (387) they are more likely to gain the recommended amount of weight during pregnancy. Moreover, women who are informed of their own target for GWG, in line with their pre-pregnancy BMI, have been found to be more likely to gain within recommended IOM ranges (286). This indicates a need not only for more frequent provision of advice, but also for provision of advice which is consistent with guidelines and across antenatal healthcare providers.

Despite inconsistencies in GWG advice, GPs in this study frequently acknowledged the importance of excess GWG, overweight and obesity on maternal and child health outcomes. Maternal conditions (gestational diabetes, pregnancy induced hypertension, postnatal depression and pre-eclampsia) were far more frequently reported as co-morbidities of excess GWG than were implications for the child (macrosomia, foetal abnormalities and higher risk of undetected foetal abnormalities).

Although behavioural interventions targeting prevention of excess GWG do exist (302, 409, 412), effective strategies that can be widely disseminated, that are cost-effective and minimally burdensome on clinicians are needed (409). For example, Oken et al (2012) suggested that electronic medical records (EMRs), used frequently as a useful tool for tracking weight, may also hold a place in clinician management of GWG (387). These authors conducted in depth interviews with obstetricians from a multi-site group practice in Massachusetts who were using EMRs as part of their practice (387). Most of the clinicians in that study reported that GWG was a significant or moderate issue in their practice and many expressed interest in additional tools specifically tailored to the EMR for GWG, for example, a chart to plot actual versus recommended weight gain based on patient BMI, as well as an alert function to identify ‘out of range’ weight gain prompting counselling the patient about excessive GWG (387). The EMR was described by the authors as having potential to improve the frequency and accuracy of GWG counselling and tracking (387) and provides an example of a clinician focussed management tool which may be useful in supporting antenatal practice. Such resources have the potential to assist healthcare providers and could be useful strategies to assist promoting healthy GWG. Further research is necessary to determine their usefulness in clinical practice.
Alternatively, an Australian government subsidised (Medicare) allied health EPC plan offered to pregnant women for healthy weight and lifestyle management might be an effective program to encourage healthy GWG. One of the GPs in this study raised the EPC plan as a potential strategy for support but outlined that pregnant women would not qualify for the program. In the current Australian Medicare system, EPC plans allow for a limited number of GP referred visits per year to allied health practitioners. Patients must be diagnosed with a chronic disease, such as obesity, alongside resulting co-morbidities (for example hypertension or hyperlipidemia), and are referred for management of these specific conditions. However pregnancy, subsequent excess weight gain and pregnancy induced co-morbidities do not qualify for management under the government subsidised EPC plan, yet long term health benefits and public health savings could potentially justify this scheme for pregnant women.

3.6 Strengths & limitations

This was the first qualitative study to explore the views of GPs regarding GWG assessment and management. Therefore, unique and valuable information has been offered, describing the barriers faced by GPs and potential strategies which might assist practitioners in their management of maternal weight gain during pregnancy. From a methodological perspective, conducting interviews allows participants space to provide information, including historical information, verbally (413). This was an efficient method used to access busy GPs in a distant location, from whom information might not have been able to be otherwise sought.

A main limitation of the study included telephone interviews used in some instances to cover accessibility issues possibly resulting in interactions not being as intimate as face-to-face interviews and not allowing the researcher an opportunity to observe the informant responses.

3.7 Conclusion & implications

This study has provided an in depth analysis of the views of GPs regarding weight management during pregnancy and identified barriers to GPs supporting women in their attainment of healthy weight gain during pregnancy. General Practitioners frequently participating in shared antenatal care identify many adverse maternal and child health outcomes associated with excess GWG, however, management of excess GWG and perspectives on the issue vary widely. From a public health perspective healthcare providers such as GPs are vital in
promoting awareness of the importance of healthy GWG. Strategies to best support GPs in their management of GWG are needed so that best outcomes are achieved for maternal and child health. In addition, provision of support across a variety of antenatal care providers such as midwives, obstetricians and dietitians warrants further investigation to determine how, within the clinical setting, women might be best supported in their attainment of healthy weight during pregnancy. Barriers to effective management of GWG should be investigated to inform future interventions targeting healthy maternal weight, in the interest of best maternal and child health outcomes in the short and long term.

The following chapter builds on this study by detailing from the woman’s perspective, the advice received regarding weight, diet and PA, both during pregnancy and following childbirth, from a range of healthcare providers other than GPs. It is important to assess the advice women receive in relation to GWG and PPWR, from a range of healthcare providers to assist in identifying further opportunities for improved provision support for healthy weight attainment.
Chapter 4

Weight and healthy lifestyle advice across the perinatal period: What advice do women receive and how does advice predict weight, diet, physical activity and sedentary behaviours?

4.1 Introduction

The previous chapter identified inconsistencies in the management of maternal weight during pregnancy provided by GPs delivering shared antenatal care. Barriers to provision of adequate support for healthy GWG were also identified. This chapter builds on the previous chapter by reporting methodology and results of a study focussed on assessing weight and healthy lifestyle advice received by women, from other antenatal clinicians, including midwives and obstetricians. The chapter reports the advice received across the perinatal period, that is, both during pregnancy and in the first few months postpartum. The association of the advice received from healthcare providers with maternal weight, diet and PA behaviours both during and following childbirth is also examined.

The antenatal period is a time whereby women are in frequent contact with a potentially wide range of health professionals (414-416) depending on their preferred choice of antenatal care. Obstetricians and midwives as well as other antenatal healthcare workers are routine providers of care within the antenatal system. In some countries this system has been estimated to reach almost 100% of the pregnant population (414, 416). In most western countries, antenatal care is part of public health promotion and prevention programs, with women usually attending five to eight visits to their healthcare provider throughout pregnancy (414, 415). Therefore, clinicians have the potential to provide broad reach, routine weight and healthy lifestyle advice to women within the antenatal system.

In contrast, much less opportunity presents in the months following childbirth for women to be seen by healthcare providers specifically in the interest of their own health. Formal, face-to-face practitioner and patient contact occurs on fewer occasions during the postpartum period, compared with during pregnancy (417). In Australia, for example, there are no consistent guidelines for the recommended frequency or schedule of routine postpartum visits (418). In Chapter 2 (2.6.3), the implications of PPWR for both the health of the mother and the child
were discussed in detail. The association between PPWR and maternal and child obesity and related morbidity was also described. However, despite the high risks for adverse weight-related outcomes associated with this postpartum life stage, fewer opportunities for mother focussed care occur during the postpartum period.

Primary care services for women during the postpartum period have been described as being inconsistent and not adequately meeting population needs (418, 419). Although some postpartum education is provided for women by nursing and other healthcare professionals, it appears that much of the education is focused on breastfeeding and care of the newborn rather than the physical and emotional health of the mother (420). Therefore, assessment of the current provision of advice from healthcare providers regarding weight, diet and PA during this phase is necessary in order to identify opportunities for promoting healthy lifestyle support.

4.1.1 Assessment of weight, diet and physical activity advice during pregnancy

Prevention of excess GWG is challenging (162, 288, 421, 422) and prioritisation of weight management is inconsistent (255, 299). Yet recent studies have shown that despite the development of the IOM GWG guidelines in 1990, many women receive no GWG advice (277, 285, 286, 421, 423) or are given GWG advice inconsistent with IOM recommendations (421, 423, 424). This reinforces that inconsistency in provision of advice is common (277, 279, 377). It has been proposed that insufficient or inaccurate knowledge transfer might be related to a woman’s inability to meet GWG recommendations (386).

Equally as important as the assessment of weight advice is the assessment of advice related to diet and PA; potentially modifiable factors associated with maternal weight status during pregnancy (425). Optimal nutrition during pregnancy is regarded as one of the most important factors influencing the health of the mother and the foetus (257, 426). Poor diet quality during pregnancy has been associated with excess GWG, pre-eclampsia, and miscarriage (427, 428). Poor infant outcomes have also been linked to poor maternal nutrition during pregnancy (427), including inadequate development, low birth weight and an increased risk of developing chronic diseases in later life (426). Yet, previous research suggests that pregnant women might not be receiving adequate nutrition advice from their healthcare provider during pregnancy (426, 429) despite evidence suggesting that pregnant women who receive targeted counselling achieve improved dietary intakes compared to those without such support (430-433).
In a similar vein, regular PA during pregnancy is associated with positive maternal and child health outcomes. For the mother, these include prevention of low back pain and urinary incontinence (414), improved cardiovascular health, less weight gain, more stable blood glucose levels and decreased risk of developing GDM (274, 422, 434). Reduced labour and delivery times as well as fewer delivery complications have also been positively associated with exercise during pregnancy (252, 274, 434, 435). Compared with women who do not exercise during pregnancy, women who do exercise whilst pregnant have been reported to have better mood and self-esteem (434) and reduced risk of depression during pregnancy and in the postpartum period (414, 436, 437). Maternal PA during pregnancy has been reported to improve functioning of the fetal autonomic nervous system, assist normalisation of birth weight (434) and is associated with reduced offspring adiposity at birth and across early childhood (36, 213, 434, 438).

Despite the many documented health benefits of PA during pregnancy, studies have shown that most pregnant women do not exercise on a regular basis (414, 439, 440) and that only approximately 5-20% of women follow exercise guidelines (414, 441, 442). Importantly, a lack of support or education from antenatal healthcare providers about the benefits or safe modes of exercise during pregnancy has been identified as a factor associated with low levels of maternal PA (443).

Why few women achieve recommended diet and PA guidelines during pregnancy remains unclear (425). Inadequate dietary intakes and low levels of PA during pregnancy may in part be reflective of women not receiving advice, or not following advice when it is provided (430). There is also a body of research suggesting that provision of advice alone is insufficient to change behaviour. For example, a growing number of antenatal interventions have compared information provision (typically a brochure or meeting with health professional) with additional behaviour change strategies (such as goal setting and behavioural monitoring) and found that information provision alone has had very little or no impact on dietary behaviours (384) or PA (441). Regardless, little is currently known about the association between advice received from healthcare providers and diet and PA behaviours during pregnancy (425). Understanding these relationships is important to ensure appropriately targeted advice for supporting women in their attainment of healthy lifestyle behaviours (425).
4.1.2 Assessment of weight, diet and physical activity advice during the postpartum period

Women’s propensity to become overweight or obese during the childbearing years has been linked not only to excess GWG but also with failure to lose excessive weight within 12 months following childbirth, and with inter-pregnancy weight gain (43, 444-446). As discussed in chapter 2 (2.6.3), for women with multiple pregnancies, the consequences of overweight and obesity and related morbidity can be intensified with each subsequent pregnancy (37, 447). Whilst PPWR increases risk of CVD and T2DM (197, 447), these risks are significantly reduced if women return to their pre-pregnancy weight by six months postpartum (197, 447), providing important rationale for supporting women to limit PPWR. Yet of the few studies that have assessed postpartum weight management provided by healthcare practitioners, provision of maternal weight advice does not appear to be a priority (275, 296, 448). For example, in a recent qualitative study (448) obstetricians reported that they generally do not advise women on postpartum weight loss. This is despite evidence suggesting that women anticipate their doctors will provide this advice (448).

As PPWR is exaggerated by an energy imbalance (259) resulting from excess energy intake and/or a reduction of energy expenditure in the months following childbirth (250, 259), assessment of maternal diet, PA patterns and sedentary behaviour, alongside potential barriers and facilitators to engaging in healthy lifestyle behaviours, are important to consider. Studies have shown that diet quality is suboptimal for women during the postpartum period (258, 415, 449, 450). Although some women may eat more healthily during pregnancy (415) these habits may discontinue following childbirth (258) with declines in adequacy of fruit and vegetable intake having been previously observed (258).

Likewise, some studies have suggested a decline in activity following childbirth, despite the many well documented benefits of regular PA during the postpartum period (263-265, 270, 271). A recent qualitative study conducted in the US found that having children was considered a major barrier to an active lifestyle in the first 12 months postpartum (451, 452). Elsewhere, having a baby has been shown to lead to greater physical inactivity compared with not having children (263, 453, 454).

The antenatal period presents as an opportune time for women to receive healthy lifestyle advice and monitoring (414) and the benefits of eating healthily and being physically active
during pregnancy and the postpartum period are clear. Yet what remains unclear is when and how frequently women receive adequate advice and importantly, how the advice influences maternal weight, diet, PA behaviours. A better understanding of the provision of advice and recommendations women receive, and how this influences behaviours, is vital to enable the identification of opportunities for provision of support for new mothers during this unique life stage. Supportive strategies may need to be embedded into the existing healthcare system or alternately be delivered via suitable lifestyle interventions which target maternal weight and healthy lifestyle behaviours.

4.2 Aims

This study focussed on reporting the advice and recommendations related to weight, diet and PA received by first time mothers and provided by clinicians across the perinatal period. It further explored the associations of advice received with maternal weight status, diet and PA patterns across the perinatal period. Therefore, the aims of this study were to:

- document the weight, dietary and PA advice given by antenatal healthcare providers, as reported by first time mothers, during pregnancy and during the first three months postpartum;
- assess the associations of weight advice received by first time mothers, with GWG, PPWR and BMI at three months postpartum;
- assess the associations of provision of dietary advice received by first time mothers, with dietary intake patterns during pregnancy and three months postpartum;
- assess the associations of provision of PA advice received by first time mothers with PA patterns and sedentary behaviour at three months postpartum.

4.3 Methods

This chapter reports data from the baseline survey of the Melbourne Infant Feeding Activity and Nutrition (InFANT) Extend trial. The three year InFANT Extend study was a cluster-randomised controlled intervention trial which recruited first time mothers and their newborns who attended first time parent groups at their local Maternal and Child Health Centres. The InFANT Extend trial aimed to promote the development of healthy child dietary and PA
behaviours. It was focussed on parenting skills and strategies and was delivered over six group sessions during the infant’s first 18 months of life. For the purpose of this chapter, the recruitment methodology and baseline data collection will be outlined; the InFANT Extend intervention components will be detailed in Chapter 5. The InFANT Extend trial was approved by the Deakin University Human Research Ethics Committee (2011-029) (2007-175) (11/02/2011) and the Victorian Government Department of Human Services, Office for Children Research Co-ordinating Committee.

4.3.1 Recruitment

The recruitment of participants enrolled in the InFANT Extend study commenced in June 2011 and concluded in July 2012. Recruitment was staggered and involved a two-stage sampling process. In stage one, local government areas (LGAs) in Victoria, Australia were purposively selected. Areas eligible for LGA selection were those areas which had not previously been involved in the earlier Melbourne InFANT trial (2008-2010) (455) and which were within a 60km radius of either of the two Deakin University research centres: Geelong campus, Geelong or Burwood campus, Melbourne. Geelong is approximately 75km south-west of Melbourne and is a considerably smaller city, with a population of approximately 251,000 people, mostly (80%) Australian born, including approximately 67,000 families (456).

To ensure likely inclusion of lower socio-economic areas, each LGA was classified by socio-economic position (SEP) as part of the selection for eligibility, prior to approaching women within different LGAs for recruitment. The Australian Bureau of Statistics Socio-Economic Indices for Areas (SIEFA) index across Victoria was used to assess area-based measurement of socio-economic disparity (457). Local Government areas with SEIFAs in the lowest quintile across the state were eligible. Ten LGAs qualified to be approached for recruitment. As one LGA did not have a sufficient number of new mothers participating in first time parent groups (the format of which is outlined below), nine LGAs were approached. Maternal and child health co-ordinators of each LGA were invited to participate. Two of the nine LGAs declined as they were already taking part in a research study. In total, seven LGAs agreed to participate in the InFANT Extend study.

In stage two, first time parent groups within each of the seven LGAs were randomly selected. In Victoria, maternal and child health nurses in each LGA facilitate regular, formal group
meetings for new mothers and their newborns at approximately six weeks postpartum. These are known as first time parent groups. Typically, meetings run across six weeks. For a group to be eligible, a minimum of eight participants were required to consent per first-time parent group within mid and higher SEP LGAs. Six participants were required per first-time parent group within the lower SEP LGAs, as participation rates tend to be low in health behaviour interventions for vulnerable population groups or low socio-economic areas (458). To be eligible, parents needed to be English literate.

Recruitment visits to selected first-time parent groups in each LGA were made by the Deakin University research team on two occasions when the groups were nearing completion. The first visit was to provide parents with an overview of the project and distribute written information, a plain language statement (PLS) and consent forms. The second visit, one week later, was to obtain informed consent for participation and to randomly assign consenting groups to either the control or intervention arm of the study when newborns were approximately 12 weeks old. To ensure an equal number of control and intervention groups within each LGA, randomisation of groups was performed separately for each LGA. If a group declined to participate, the next group on a random order list within the given LGA was approached for recruitment. Both control and intervention groups had been pre-allocated based on the group’s recruitment order within each LGA. The researchers were blinded to the allocation of each group to trial arm up until the provision of informed consent.

4.3.2 Data collection

Data collection for both the intervention and control arms occurred at baseline (when children were approximately three months of age and mothers were approximately three months postpartum), when children were approximately nine months of age, and 18 months of age and at study completion (i.e. when children were approximately three years old). This chapter reports baseline data only. Chapter 5 provides detail regarding data collection at both mid-intervention (when mothers were approximately nine months postpartum) and at follow up when mothers were approximately 18 months postpartum.

A ‘main carer’ survey (Appendix 3) and a ‘partner survey’ were distributed to all mothers at the second recruitment visit when women consented to take part in the study. They were asked to bring their completed surveys to their first InFANT Extend session, scheduled approximately
one week later. Surveys were hand checked by researchers at the session and missing details were collected. Women who did not bring their completed questionnaire to the session were given a reply-paid envelope to return their questionnaires via mail, with up to two reminder telephone calls given after that if necessary.

4.3.3 Measures

The tools and measures used to assess baseline characteristics of the sample, outcome measures and potential confounding factors are outlined below. In some instances, when the number of responses in each category were too few to perform statistical analysis, categories were collapsed. For the purpose of this thesis, a description of data from the ‘main carer’ survey only has been included. Several measures described below are also referred to in Chapters 5 and 6.

Maternal demographics

Maternal demographic questions (Appendix 3, section D) included date of birth (used to calculate age); marital status, measured by a single item with responses collapsed into four categories: ‘married’, ‘de facto’, ‘separated/divorced’ and ‘never married’; country of birth, measured by a single item with responses collapsed into four categories: ‘Australia’, ‘UK’, ‘New Zealand’ and ‘other’; weekly household income, measured by a single item with responses collapsed into four categories: ‘$1-1499’, ‘$1500-1999’, ‘$2,000 or more’ and ‘unsure/don’t want to answer’; education, measured by a single item with responses collapsed into three categories: ‘no qualification/up to year 12’, ‘trade/apprentice/certificate/diploma’, and ‘university degree/higher degree’ and current employment status, measured by a single item with responses collapsed into four categories: ‘full time work’, ‘part time work’, ‘keeping house/raising children full time’ and ‘studying full time/unemployed’.

Health-related factors were also assessed. These included smoking status, measured by two items, one of which assessed current smoking status with four responses ranging from ‘I have never smoked’ to ‘I now smoke regularly’; and a second item assessing smoking status during pregnancy with three responses including ‘yes, every day’ (and on average the number of cigarettes smoked / day was given), ‘yes, but occasionally’ (less than 1 cigarette / day) and ‘no, I did not smoke during my pregnancy’. For the purpose of this chapter, responses to the questions on smoking were collapsed into two categories: ‘yes’ or ‘no’ for both during and
following pregnancy. Breastfeeding status was measured by a single item with responses ranging from ‘breastfeeding exclusively’ to ‘combination breast and formula feeding’ and ‘formula feeding’ or ‘cow’s milk’ only. For the purpose of this chapter, responses were collapsed into three categories: ‘breastfeeding exclusively’ (breastfeeding exclusively (no other food or fluids)), ‘breastfeeding partially’ (breastfeeding fully with occasional water and juices or combination breast and formula feeding), or ‘formula feeding only’. As there were no responses to ‘cow’s milk only’ this category was excluded.

**Anthropometry**

Pre-pregnancy weight and GWG were self-reported from one item each in the self-administered questionnaire (Appendix 3, section E). Self-reported pre-pregnancy weight has been widely used in population studies (286, 290, 425) and has been shown to be a reasonable estimate of maternal weight prior to pregnancy (184, 425). Postpartum weight was measured by trained research staff. Women were weighed at approximately three months postpartum, at their first InFANT Extend session. When mothers were unable to attend the first InFANT Extend session, they were visited in their homes to be weighed and measured. Prior to commencement of data collection, several research staff responsible for collecting anthropometric data completed a formal training workshop to ensure consistency in measurement techniques and adherence to data collection protocols. The training ensured inter- and intra-rater reliability of measurements. All equipment used for anthropometry measurements were calibrated prior to the beginning of the InFANT Extend intervention and approximately mid-way through the intervention.

Weight in light clothing and with shoes removed was measured once using Tanita digital scales (Model 1582) and recorded to the nearest 0.01kg. Height was measured using a Victar stadiometer. Two measurements were taken separately and were recorded to the nearest 0.1cm. If the two measurements disagreed by 0.5cm or more, a third measurement was taken and recorded. The average of two or three (n=54) height measurements was used to calculate maternal pre-pregnancy BMI and postpartum BMI, calculated as (weight (kg) / height (m)^2). Body Mass Index classification was according to WHO and Australian National Health and Medical Research Council criteria (underweight (BMI < 18.5), healthy weight (BMI 18.5 to < 24.9), overweight (BMI 25.0 to < 29.9) or obese (BMI ≥ 30.0)) (459, 460).
Self-reported measures are one of the most common ways to collect anthropometric data and have been shown to have advantages of being practical, convenient to administer and are a lower cost method compared with objective (measured) methods (461). Yet tools for self-report have been shown to have multiple limitations (461). Participants self-reporting data may misunderstand questions, may not accurately recall past events and response bias and social desirability is common (461, 462). Results from a systematic review comparing direct versus self-reported measures for assessing height, weight and BMI from 64 studies (461) showed that height tended to be overestimated and weight and BMI underestimated. Their findings were consistent with findings from previous systematic reviews in adults (463, 464). As such, objectively measured anthropometry has been recommended to improve measurement precision (461) and these methods were used where possible for data collection. Therefore, if no height measurement was available at the first InFANT session, or via the home visit, the next available height measured at the following InFANT session (either session three (six months later) or session six (12 months later)) was the height used to calculate BMI. This was the case for 11 women; height measures were used from session three for four women and from session six for seven women.

Excess GWG was defined as weight gain exceeding the 2009 IOM recommendations (67), a universally used reference for multiple studies which have assessed pregnancy weight gain (162, 315, 384, 449, 465). Postpartum weight retention was calculated as the difference between objectively measured weight at three months postpartum and self-reported pre-pregnancy weight. Whilst this method does not take into account the possibility of maternal weight gain during the first few months following childbirth (466), in this case, it relies on only one self-reported measure of weight (pre-pregnancy) rather than both GWG and pre-pregnancy self-reported measures. This method has been used for calculating PPWR in multiple studies of varying design assessing maternal PPWR (207, 218), as well as a recent large Norwegian prospective cohort pregnancy study which assessed PPWR of approximately 95, 200 women (467). This method is considered a standard method for calculating PPWR (67).

Dietary intake

Dietary intake was assessed using the Cancer Council of Victoria’s (CCV) Dietary Questionnaire for Epidemiological Studies (DQES) version 3.1 Food Frequency Questionnaire (FFQ) (468) (Appendix 4). The DQES assesses usual food consumption over the previous 12
months, capturing food intake across the nine months of pregnancy and during the first three months following childbirth. The DQES comprises a food list of 74 items with ten response options assessing frequency of intake from ‘never’ to ‘3 or more times per day’(468). The food items are grouped into the categories: cereal foods, sweets and snacks, dairy products, meats and fish, fruit, and vegetables. Food Frequency Questionnaires are used commonly for dietary assessment (469). The CCV’s DQES has been previously validated against seven day weighed food records (470, 471) and has been shown to be a useful assessment of dietary intake in the Australian population (471, 472).

All DQES data was cleaned in accordance with instructions provided by the CCV (468). Usual intake of fruits, vegetables, non-core snack foods and soft drinks were assessed. One item (Q15) asked women to report their usual intake of fruit as serves per day with responses collapsed into five categories: ‘zero or less than one serve’, ‘1 serve’, ‘2 serves’, ‘3 serves’ and ‘4-6 serves’. A separate item assessed intake of vegetables (including potatoes) (Q16) as serves per day, with responses collapsed into six categories: ‘1 serve or less’, ‘2 serves’, ‘3 serves’, ‘4 serves’, ‘5 serves’ and ‘6-7 serves’. In both instances, a serving sizes guide was given to assist in quantification of intake. Where a response was given as ‘less than one serve of fruit per day’ or ‘less than one serve of vegetables per day’, this was coded as 0.5 serves. Fruit and vegetable intake responses could therefore be compared with Australian adult recommendations for daily fruit and vegetable intake (473).

One item (Q10) asked women to report their usual intake of regular (non-diet) soft drink, reported in glasses per day with responses collapsed into three categories: ‘none’, ‘less than one glass’ and ‘one glass or more’. Intake of non-core snack foods (six items) was assessed using a ten-point scale with possible responses ranging from ‘never’ to ‘3 or more times per day’ (Q25). Intake of each non-core snack food was converted to a numerical daily equivalent frequencies (DEF) as per the protocol outlined by the CCV (468). For example, a response of ‘less than once per month’ was given a DEF score of 0.02; ‘3-4 times per week’ was given a DEF score of 0.5; ‘once per day’ was given a DEF score of 1, and so on. The continuous DEF of each non-core snack food item was summed to give a total non-core snack food intake score.
Physical activity

Postpartum PA (duration and intensity) was assessed using the Australian Institute of Health and Welfare’s Active Australia Survey (AAS) (474, 475) included in the ‘main carer’ survey (Appendix 3, section F). A total of eight items assessed participation in varying intensities of walking and other PA in the previous week. As this tool reports PA in the last week prior to survey completion, PA data during pregnancy was unable to be assessed. Assessment of PA during pregnancy was beyond the scope of the InFANT Extend RCT and did not coincide with the InFANT Extend study aims. The AAS has been used frequently to assess PA in Australian adult populations (476-478). Test-retest reliability has been previously established in Australian (477, 479-481) and US (482) adult populations and equal to that of the International Physical Activity Questionnaire (474, 476). The AAS has been previously validated against accelerometers in Australian (481) and US women (482).

Women were asked to estimate the total duration (number of times and total hours and minutes) they spent walking continuously (for at least ten minutes) for recreation, exercise or to get from place to place, and doing both vigorous and moderate PA in the week prior to completing the questionnaire. They were also asked to estimate the total duration (number of times and total hours and minutes) they spent in moderate and vigorous activities which excluded household chores, gardening or yard work. Total PA time (min/week) was calculated from the total time spent walking, time spent in moderate PA and twice the time spent in vigorous PA. The doubling of time spent in vigorous activity is as per the AAS protocol, as vigorous activity has been shown to confer greater health benefits than moderate activity (474). In accordance with the AAS protocol, sufficient PA time (min/week) was calculated by summing time spent in walking, moderate activity and vigorous activity (474, 483). To avoid the possibility of errors due to over-reporting, any times greater than 840 min/week for a single type of activity were truncated to 840 min/week (14 hours) (474, 483). In addition, for any participant whose total time in all activities was greater than 1680 min/week (28 hours), this was truncated to 1680 min/week as per the survey protocol (474, 483). Categorical variables were created to define ‘sufficient minutes’ of PA (≥ 150 minutes per week), ‘sufficient sessions’ (≥ 5 sessions per week) and ‘sufficient activity’ (≥ 150 minutes per week plus ≥ 5 sessions per week) (474). These variables were then used to determine if women were meeting Australian PA recommendations (‘sufficient activity’ (≥ 150 minutes per week plus ≥ 5 sessions per week))
or not. Women were classified as being ‘inactive’ if their combined total time spent walking, in moderate activity and in vigorous activity was equal to zero, as per the AAS protocol.

**Sedentary behavior**

The ‘main carer’ questionnaire assessed a marker of sedentary behavior, time spent sitting whilst viewing television/DVD/videos (henceforth ‘TV/DVD/video time’ was used as a proxy for sedentary time). Usual ‘TV/DVD/video time’ was assessed by two items (Appendix 3, section F), an abridged version of a previously validated questionnaire (484). Women were asked to report the usual time (hours and minutes) on a weekday and separately on a weekend day, that they spent sitting watching TV or videos/DVDs. An average daily time (min/day) was calculated by summing the time reported for weekdays (multiplied by five (weekdays per week)) with the time reported for weekend days (multiplied by two (two weekend days per week) and dividing that score by seven. Reported durations and total viewing time were truncated to 1080 min/day (18 hours) as per previous methodology employed for the earlier Melbourne InFANT trial (483).

**Clinician advice**

Provision of healthcare provider advice during pregnancy was measured by a single item, purposefully designed, that asked women if during their pregnancy, a doctor, nurse or other healthcare provider talked with them about any of the topics listed (Appendix 3, section E). Eight sub-items required a ‘yes/no’ response. Four of the sub-items were relevant to this study; two sub-items related to weight advice: ‘how much weight you should gain during pregnancy’ and ‘avoiding gaining too much weight during pregnancy’, one item assessed dietary advice: ‘eating a healthy diet during pregnancy’ and one item assessed PA advice: ‘being physically active during pregnancy’. Provision of healthcare provider advice during the postpartum period was measured by a single item which asked women if, since delivering their baby, they had received advice from their doctor, nurse or other healthcare worker about any of the topics listed. Five sub-items required a ‘yes/no’ response. Four of the sub-items were relevant to this study; two sub-items related to weight advice: ‘how much you should now weigh’ and ‘programs or resources to help you lose weight after pregnancy’, one item assessed dietary advice: ‘eating a healthy diet’ and one item assessed PA: ‘being physically active’.
4.3.4 Data management and statistical analyses

Questionnaires were manually checked for errors by trained research assistants. When data were missing mothers were contacted by telephone and the relevant data was collected. In cases where data were not able to be obtained, data remained missing and was subsequently excluded from the analyses. The FFQ data was scanned by the CCV and transferred into an appropriate datasheet for analysis. Missing items for dietary intake were coded as ‘none’ or ‘never’. All other data arising from the questionnaire, as well as anthropometry data and maternal details were entered by research staff into a custom designed Microsoft Access database. Data were then transferred into SPSS statistical package and a range of logical checks were performed. Data were analysed using SPSS statistical package version 21, or for regression analyses assessing associations of healthcare provider advice with maternal health outcomes Stata Version 12 was used to allow controlling for clustering.

Analyses included descriptive statistics to characterise the sample and distributions of key variables. Chi squared analyses were used to assess differences in the proportions of women who were underweight and/or healthy weight and overweight/obese from pre-pregnancy to three months postpartum and to assess differences in the proportion of women receiving advice during pregnancy compared with during the postpartum period. Continuous outcome measures were checked for normality. Physical activity data (total (min/week) and walking (min/week)) sitting/sedentary data (total (min/day)) and total DEF scores for non-core foods were found to be abnormally distributed and as such were transformed using square root or log transformations. For associations of healthcare provider advice with maternal weight, diet, PA and sedentary behavior outcomes, linear regression was conducted when outcomes were continuous. For example, when outcomes were GWG or PPWR. Either binomial or multinominal logistic regression were conducted when outcomes were categorical. When pre-pregnancy BMI category was included in the regression analyses as either an outcome variable or as a confounding factor, women who were classified as underweight were combined with healthy weight women as there were too few women (n=10) classified as underweight for the purpose of the analyses. Statistical significance was set as p <0.05 for all analyses.
**Confounding factors**

The rationale for adjusting for various confounding factors in the analyses was based on previously established predictors of the outcome variables. Pre-pregnancy BMI has been frequently associated with GWG (285, 303, 485) and GWG has consistently been shown to be the strongest predictor of PPWR (37, 67, 239, 279, 486, 487). Both pre-pregnancy BMI and GWG were therefore included in the adjusted analyses. In addition and consistent with other studies which have previously assessed maternal weight both during and following pregnancy, age, education, and income were also adjusted for (94, 180, 184, 190, 488, 489). Smoking was not included as a confounding factor due to the very low proportion of women (3.8%) who reported smoking during pregnancy.

Maternal age, education, income and BMI have previously been associated with diet when assessing maternal dietary patterns across the perinatal period (475, 490-492) and thus were included in the current adjusted analyses. Likewise, consistent with other studies assessing maternal PA and sedentary behaviours during the postpartum period, maternal age, education, income, and BMI (as a continuous measure) were adjusted for in the present analyses (190, 493). Furthermore, maternal age, education level and pre-pregnancy BMI have previously been considered predictors of diet, PA and sedentary behavior outcomes in data assessing outcomes from the earlier Melbourne InFANT study (483), and as such this contributed to the rationale for adjusting for these factors in the current analyses. Finally, for all regression analyses, the design effect by which women were recruited via maternal health groups was accounted for by clustering by first-time parents’ groups. This was done by using the ‘cluster by’ command in Stata. Adjustment for clustering within the analyses is necessary when assessing data generated with a cluster-randomised trial such as the InFANT Extend RCT (494) and accounts for the design effect and expected intra-cluster correlations of maternal characteristics within a first-time parent group.

### 4.4 Results

#### 4.4.1 Participants

A total of 477 women from 62 first-time parent groups were recruited to the InFANT Extend RCT from 531 women approached (90%). Of the 62 groups, 28 were classified by SEIFA as
low SEP, 20 as medium and 14 as high SEP. Although recruitment for the InFANT Extend study did not exclude fathers, they seldom attended the InFANT Extend sessions and were not identified as being the main career in any instance. The present analyses excluded mothers with non-singleton pregnancies (n=6) and those who did not provide detail regarding parity (n=6). Those women who were not first time mothers (n=15) were also excluded and survey data were missing for two women, leaving a total of 448 women whose data could be included in the analyses.

Characteristics of included women are presented in Table 4.1. Mean age of the women was 31.9±4.25 years. Mean pre-pregnancy BMI was 24.8±4.88kg/m². Women were predominately Australian born (75.9%), married (74.1%), non-smokers (94.7%) and were keeping house/raising children full time (88.6%), with few women working full-time or part-time at the time of survey completion (9.7%). Over half of the sample (58.4%) were university educated or had a higher university degree. Weekly household income varied widely with approximately one third of women (29.7%) reportedly having a weekly household income of $2,000 or greater. Approximately half (49.6%) of women were exclusively breastfeeding at baseline.
### Table 4.1 Maternal characteristics

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Mean ± SD</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maternal age (years)</td>
<td>31.9±4.25</td>
<td>19.3-43.5</td>
</tr>
<tr>
<td>Pre-pregnancy weight (kg) (n=445)</td>
<td>67.1±14.34</td>
<td>35.0-155.0</td>
</tr>
<tr>
<td>Pre-pregnancy BMI (kg/m²) (n=430)</td>
<td>24.8±4.88</td>
<td>16.3-55.0</td>
</tr>
<tr>
<td>Postpartum BMI (kg/m²) (n=416)</td>
<td>26.2±5.00</td>
<td>17.1-46.8</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Marital status</td>
</tr>
<tr>
<td>Married</td>
</tr>
<tr>
<td>De facto</td>
</tr>
<tr>
<td>Separated/Divorced</td>
</tr>
<tr>
<td>Never married</td>
</tr>
</tbody>
</table>

| Birth country                                    |                |
| Australia                                        | 75.9           |
| UK                                               | 3.3            |
| New Zealand                                      | 2.2            |
| Other                                            | 18.5           |

| Weekly household income (n=433)                   |                |
| $1-1499                                          | 36.7           |
| $1500-1999                                       | 22.0           |
| $2000 or more                                    | 29.7           |
| Unsure/Don’t want to answer                      | 11.6           |

| Education (n=447)                                 |                |
| No qualification/up to year 12                    | 11.6           |
| Trade/apprentice/certificate/diploma              | 30.0           |
| University degree/Higher degree                   | 58.4           |

| Employment status (n=446)                          |                |
| Full time work                                    | 3.4            |
| Part time work                                    | 6.3            |
| Keeping house/raising children full time          | 88.6           |
| Studying full time/Unemployed                     | 1.8            |

| Smoking during pregnancy                           |                |
| Yes                                               | 3.8            |
| No                                                | 96.2           |

| Smoking currently                                 |                |
| Yes                                               | 5.4            |
| No                                                | 94.7           |

| Breastfeeding                                     |                |
| Exclusive breastfeeding                            | 49.6           |
| Breastfeeding combined with formula or other fluids| 28.1           |
| Formula feeding only                              | 22.3           |

n=448 unless otherwise stated
4.4.2 Maternal weight, diet and physical activity behaviours

Maternal weight change from pre-pregnancy to three months postpartum is presented in Table 4.2. Two thirds (60.0%) of women had a healthy pre-pregnancy BMI, with just over one third of all women classified as either overweight or obese pre-pregnancy (37.7%). The proportion of combined underweight and healthy weight women decreased significantly from pre-pregnancy to three months postpartum (-24%) (p<0.001) and the proportion of women classified as overweight and obese (combined) significantly increased by 30% (p<0.001).

Mean GWG was 14.0±6.08kg. Women who were obese pre-pregnancy gained significantly less weight, on average during pregnancy (10.9±7.54kg), compared to women with a healthy BMI (14.4±5.07kg) (p=0.001) and women who were overweight (14.4±6.50kg) (p=0.003). Mean PPWR was 4.3±5.75kg. Women who were obese pre-pregnancy retained significantly less weight, on average (1.9±6.41kg) compared to women with a healthy BMI (4.4±5.51) (p=0.023) and women who were overweight (5.0±5.84) (p=0.009).
<table>
<thead>
<tr>
<th>Table 4.2 Maternal weight change from pre-pregnancy to three months postpartum</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>BMI category (%)</strong></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Underweight</td>
</tr>
<tr>
<td>Healthy</td>
</tr>
<tr>
<td>Overweight</td>
</tr>
<tr>
<td>Obese</td>
</tr>
<tr>
<td>Mean ± SD</td>
</tr>
<tr>
<td>GWG (kg) (n=434)</td>
</tr>
<tr>
<td>Underweight</td>
</tr>
<tr>
<td>Healthy</td>
</tr>
<tr>
<td>Overweight</td>
</tr>
<tr>
<td>Obese</td>
</tr>
<tr>
<td>PPWR (kg) (n=415)</td>
</tr>
<tr>
<td>Underweight</td>
</tr>
<tr>
<td>Healthy</td>
</tr>
<tr>
<td>Overweight</td>
</tr>
<tr>
<td>Obese</td>
</tr>
</tbody>
</table>

*Change in number of women in the combined underweight/healthy weight BMI category and overweight/obese category from pre-pregnancy to 3 months postpartum

^the difference in GWG (kg) and PPWR (kg) when ‘obese’ was used as the reference category
The proportion of women who gained weight below, within and in excess of IOM recommendations for GWG is presented in Table 4.3. Overall, 41.0% of all women exceeded IOM recommendations. A higher proportion of overweight (63.8%) and obese (56.9%) women exceeded the recommendations compared with underweight (20.0%) and healthy weight (29.1%) women. Compared with healthy weight women (n=258), those who were overweight (n=110) or obese (n=52) pre-pregnancy, were more likely to exceed IOM recommendations for GWG (OR=4.3, 95% CI=2.7, 7.0 and OR=3.2, 95% CI=1.7, 6.0 respectively).

Table 4.3 Gestational weight gain and odds of exceeding IOM recommendations by pre-pregnancy BMI category

<table>
<thead>
<tr>
<th>BMI Category</th>
<th>Below recommendations</th>
<th>Within recommendations</th>
<th>Exceeded recommendations</th>
<th>OR* (95%CI)</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total sample</td>
<td></td>
<td></td>
<td></td>
<td>n</td>
<td>%</td>
</tr>
<tr>
<td>Below recommendations</td>
<td>88</td>
<td>158</td>
<td>171</td>
<td>21.1</td>
<td>37.9</td>
</tr>
<tr>
<td>Within recommendations</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Exceeded recommendations</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Underweight</td>
<td></td>
<td></td>
<td></td>
<td>n</td>
<td>%</td>
</tr>
<tr>
<td>Below recommendations</td>
<td>5</td>
<td>3</td>
<td>2</td>
<td>50.0</td>
<td>30.0</td>
</tr>
<tr>
<td>Within recommendations</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Exceeded recommendations</td>
<td></td>
<td></td>
<td></td>
<td>2</td>
<td>20.0</td>
</tr>
<tr>
<td>Healthy weight</td>
<td></td>
<td></td>
<td></td>
<td>n</td>
<td>%</td>
</tr>
<tr>
<td>Below recommendations</td>
<td>65</td>
<td>113</td>
<td>73</td>
<td>25.9</td>
<td>45.0</td>
</tr>
<tr>
<td>Within recommendations</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Exceeded recommendations</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Overweight</td>
<td></td>
<td></td>
<td></td>
<td>n</td>
<td>%</td>
</tr>
<tr>
<td>Below recommendations</td>
<td>9</td>
<td>29</td>
<td>67</td>
<td>8.6</td>
<td>27.6</td>
</tr>
<tr>
<td>Within recommendations</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Exceeded recommendations</td>
<td></td>
<td></td>
<td></td>
<td>67</td>
<td>63.8</td>
</tr>
<tr>
<td>Obese</td>
<td></td>
<td></td>
<td></td>
<td>n</td>
<td>%</td>
</tr>
<tr>
<td>Below recommendations</td>
<td>9</td>
<td>13</td>
<td>29</td>
<td>17.6</td>
<td>25.5</td>
</tr>
<tr>
<td>Within recommendations</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Exceeded recommendations</td>
<td></td>
<td></td>
<td></td>
<td>29</td>
<td>56.9</td>
</tr>
</tbody>
</table>

* Odds Ratio for exceeding IOM recommendations for GWG when healthy weight was the reference category

^Logistic regression; model unadjusted

Maternal dietary intake is presented in Table 4.4. Approximately half of all women (55.4%) met fruit recommendations (2 or more serves/day) (473). In contrast, just 8.6% of all women met recommendations for vegetable intake defined as 5 or more serves/day (473). When combined fruit and vegetable intake was assessed, just 7.2% of all women met recommendations for both. Approximately half (53.4%) of all women reported consuming less than one glass of regular soft drink per day and approximately one third of all women (33.0%)
did not consume soft drink on a daily basis. Mean total non-core snack food DEF score, comprised of six non-core sweet and savoury snack foods was 1.39±1.18 and ranged from 0.02 to 10.85 DEF.

Table 4.4 Maternal dietary intake across the perinatal period

<table>
<thead>
<tr>
<th>Daily fruit intake (n=442)</th>
<th>n (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Zero or less than one serve</td>
<td>75 17.0</td>
</tr>
<tr>
<td>1 serve</td>
<td>123 27.8</td>
</tr>
<tr>
<td>2 serves</td>
<td>164 37.1</td>
</tr>
<tr>
<td>3 serves</td>
<td>66 14.9</td>
</tr>
<tr>
<td>4-6 serves</td>
<td>14 3.2</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Fruit intake meeting recommendations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
</tr>
<tr>
<td>No</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Daily vegetable intake</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 serve or less</td>
</tr>
<tr>
<td>2 serves</td>
</tr>
<tr>
<td>3 serves</td>
</tr>
<tr>
<td>4 serves</td>
</tr>
<tr>
<td>5 serves</td>
</tr>
<tr>
<td>6-7 serves</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Vegetable intake meeting recommendations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
</tr>
<tr>
<td>No</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Combined fruit and vegetable intake meeting recommendations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
</tr>
<tr>
<td>No</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Daily soft drink intake</th>
</tr>
</thead>
<tbody>
<tr>
<td>None</td>
</tr>
<tr>
<td>Less than one glass</td>
</tr>
<tr>
<td>1 glass or more</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Mean ± SD</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Non-core snack food intake score total (DEF)^</td>
<td>1.39±1.18</td>
</tr>
<tr>
<td>Chocolate or confectionary containing chocolate</td>
<td>0.42±0.47</td>
</tr>
<tr>
<td>Confectionary</td>
<td>0.21±0.33</td>
</tr>
<tr>
<td>Ice cream</td>
<td>0.18±0.23</td>
</tr>
<tr>
<td>Cakes or sweet pastries</td>
<td>0.19±0.21</td>
</tr>
<tr>
<td>Sweet biscuits</td>
<td>0.28±0.36</td>
</tr>
<tr>
<td>Corn chips, potato crisps</td>
<td>0.10±0.13</td>
</tr>
</tbody>
</table>

^ Daily Equivalent Frequency
n=442 for all analyses
Postpartum PA patterns and sedentary behaviour (TV/DVD/video time) are presented in Table 4.5. Overall, mean total PA time was 350.94±281.10 min/week. Time spent walking (251.97±196.78 min/week), on average, was greater than time spent in moderate (36.68±88.58 min/week) or vigorous activity (61.74±109.96 min/week). Overall, 63.2% of women were meeting PA recommendations defined as ≥150 minutes per week plus ≥5 sessions per week (474). Mean TV/DVD/video time was greater on weekdays (242.09±230.40 min/day) compared to weekend days (175.60±118.70 min/day) and 2.0% of all women were classified as inactive.

**Table 4.5 Postpartum physical activity patterns and sedentary behaviours**

<table>
<thead>
<tr>
<th></th>
<th>n</th>
<th>Mean ± SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Postpartum PA (min/week)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>445</td>
<td>350.94±281.10</td>
</tr>
<tr>
<td>Walking</td>
<td>447</td>
<td>251.97±196.78</td>
</tr>
<tr>
<td>Moderate</td>
<td>446</td>
<td>36.68±88.58</td>
</tr>
<tr>
<td>Vigorous</td>
<td>448</td>
<td>61.74±109.96</td>
</tr>
</tbody>
</table>

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Postpartum TV/DVD/video time (min/day)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>447</td>
<td>223.10±188.74</td>
</tr>
<tr>
<td>Weekday</td>
<td>447</td>
<td>242.09±230.40</td>
</tr>
<tr>
<td>Weekend day</td>
<td>447</td>
<td>175.60±118.70</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>n</th>
<th>(%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Meeting weekly PA recommendations* (n=446)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>282</td>
<td>63.2</td>
</tr>
<tr>
<td>No</td>
<td>155</td>
<td>34.8</td>
</tr>
<tr>
<td>Classified as inactive</td>
<td>9</td>
<td>2.0</td>
</tr>
</tbody>
</table>

*≥150 minutes per week plus ≥5 sessions per week

**4.4.3 Clinician advice and associations with maternal health outcomes**

Table 4.6 shows the proportion of women who reported receiving weight, diet and PA advice during pregnancy and the postpartum period, and associations of advice received with maternal health outcomes. Just over half (54.4%) of all women reported receiving advice regarding how much weight to gain during pregnancy, whilst 42.6% reported receiving advice to avoid excess GWG. During the postpartum period, a significantly lower proportion of women (5.8%) reported that they had received advice about how much they should now weigh and 8.3% reported receiving advice about programs to support weight loss. In contrast, most women
(87.1%) received advice regarding healthy eating during pregnancy and advice regarding PA (82.8%; data not presented). A significantly lower proportion of women (47.5%) (p<0.001) reported receiving healthy eating advice or PA advice (51.9%) (p<0.001) during the postpartum period.

There was no significant association found between healthcare provider advice during pregnancy regarding how much weight to gain or to avoid excess weight gain and either GWG (kg) or gaining weight within IOM recommendations. Further, there was no significant association found between dietary advice received during pregnancy and fruit or vegetable intake meeting recommendations, or with soft drink intake or intake of non-core snack foods. In relation to associations between healthcare provider advice regarding postpartum weight or programs to support weight loss, there was no association with either PPWR (kg) or BMI at three months postpartum. Further, there was no significant association found between dietary advice received during the postpartum period and whether fruit or vegetable intakes were meeting recommendations, with soft drink intake (glasses/day) or intake of non-core snack foods. For PA and sedentary behaviour, no significant association was found between healthcare provider advice to be physically active with total PA time, time spent walking, whether PA levels were meeting recommendations, or with sedentary behaviour.
Table 4.6 Associations of healthcare provider advice received with maternal weight, diet, physical activity and sedentary behaviours across the perinatal period

<table>
<thead>
<tr>
<th></th>
<th>n</th>
<th>(%)</th>
<th>β-coef (95%CI)</th>
<th>p-value</th>
<th>OR/RRR (95%CI)</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>During pregnancy</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Did a doctor, nurse, or other</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>healthcare worker talk with</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>you about:</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>How much weight you should</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>gain during pregnancy?</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>244</td>
<td>54.5</td>
<td>-0.17 (-1.30, 0.97)</td>
<td>0.765</td>
<td>0.87 (0.57, 1.33)</td>
<td>0.506</td>
</tr>
<tr>
<td>No</td>
<td>204</td>
<td>45.5</td>
<td>GWG (kg)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Avoiding gaining too much</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>weight during pregnancy?</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>191</td>
<td>42.6</td>
<td>-0.48 (-1.63, 0.67)</td>
<td>0.405</td>
<td>0.91 (0.57, 1.44)</td>
<td>0.679</td>
</tr>
<tr>
<td>No</td>
<td>257</td>
<td>57.4</td>
<td>GWG within IOM</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Eating a healthy diet during</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>pregnancy?</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>390</td>
<td>87.1</td>
<td>Fruit intake meeting</td>
<td>1.19 (0.64, 2.23)</td>
<td>0.580</td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>58</td>
<td>12.9</td>
<td>recommendations</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Soft drink intake (glasses)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Less than one glass</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>One glass or more</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Non-core snack food DEF score</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>-0.08 (-0.22, 0.06)</td>
<td>0.282</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Since delivering this baby##

Has a doctor, nurse, or other healthcare worker talked with you about:

| How much you should now weigh? | Yes | 26 | 5.8 | PPWR (kg) | 0.81 (-0.47, 2.08) | 0.210 |
| No | 422 | 94.2 | Postpartum BMI | Overweight | 1.67* (0.66, 4.23) | 0.278 |
| | | | | Obese | 2.46* (1.06, 6.06) | 0.049 |

| Programs or resources to help you lose weight after pregnancy? | Yes | 37 | 8.3 | PPWR (kg) | 1.12 (-1.05, 3.29) | 0.306 |
| No | 411 | 91.7 | Postpartum BMI | Overweight | 0.93* (0.34, 2.56) | 0.887 |
| | | | | Obese | 1.01* (0.43-2.36) | 0.983 |

| Eating a healthy diet? | Yes | 213 | 47.5 | Fruit intake meeting recommendations | 0.91 (0.58-1.43) | 0.668 |
| No | 235 | 52.5 | Veg intake meeting recommendations | 0.69 (0.31-1.54) | 0.363 |
| | | | Soft drink intake (glasses) | | |
| | | | Less than one glass | | |
| | | | One glass or more | | |
| | | | Non-core snack food DEF score | 0.05 (-0.03, 0.13) | 0.225 |

| Being physically active? | Yes | 231 | 51.9 | PA (min/week) | 0.50 (-0.99, 2.00) | 0.504 |
| No | 214 | 48.1 | Total time | 0.16 (-1.03, 1.35) | 0.791 |
| | | | Walking | 1.08 (0.73, 1.60) | 0.702 |

#Linear/logistic regression controlling for maternal age, education, income, pre-pregnancy BMI and/or GWG and clustering by first time mother’s group
##Linear/logistic regression controlling for maternal age, education, income, postpartum BMI and/or GWG and clustering by first time mother’s group
*where soft drink intake ‘none’ was used as the reference category
*where healthy weight was used as the reference category
4.5 Discussion

This chapter has documented the methodology and results from Study 2 of the thesis and shown that maternal weight, dietary intakes and PA behaviours were largely at odds with recommendations for good health. In addition, advice for weight, diet and PA was provided more frequently during pregnancy than during the postpartum period. Further, when advice was received it did not appear to influence either weight gain or behavioural outcomes in first time mothers.

The assessment of maternal weight across pregnancy and during the early postpartum months are of considerable interest. The average maternal BMI increased by over one unit from pre-pregnancy to three months postpartum. Moreover, the proportion of women who were classified as either overweight or obese increased by roughly 30% from pre-pregnancy to three months postpartum. The change in mean BMI and also the significant increase in the proportion of overweight and obese women can likely be explained by a combination of excess GWG and/or PPWR. As such, supporting women in their attainment of healthy GWG and weight loss following childbirth is likely to be key in promoting healthy weight trajectories for women in this life phase, and ideally would be addressed as part of routine maternal care.

Almost half of all women in this study exceeded IOM recommendations for GWG, yet less than half of the women reported receiving advice to avoid excess GWG. These results are not surprising considering the inconsistencies in GP delivered GWG management identified in the previous chapter. Overweight and obese women in this study were more likely to have gained in excess of IOM recommendations. Considering almost half of all women enter pregnancy already overweight or obese (41, 42) and that excess GWG is the strongest predictor of PPWR (487, 495-497), the need to focus on the promotion of healthy weight gain for these women is further highlighted.

Whilst the exact nature of the advice provided to women regarding recommendations for GWG was not assessed, it might be reasonable to assume that advice was varied. There are no formal guidelines in Australia to advise targets for GWG. This could promote inconsistent advice; a hypothesis supported by the results of the previous chapter as well as results of other studies assessing management of GWG (285, 313). For example, in a recent Australian study only 32% of obstetric, midwifery and allied health clinicians (n=73) were aware of existing
guidelines for GWG, with one quarter indicating that they did not provide women with GWG advice relative to BMI category (498). Likewise, in an earlier Australian study (499), whilst the majority (77%) of obstetric and midwifery staff (n=103) reported advising women about weight gain during pregnancy, only 22% of clinicians set specific weight or weight gain targets when counseling pregnant women (499). This is an important consideration, as when healthcare providers include targets for GWG as part of their practice, studies suggest that women often adhere to guidelines (66, 286, 290).

Similar to the results presented in Chapter 3, results of this study showed that healthy weight was generally not a focus of pregnancy management by healthcare providers. To an even lesser extent was weight a focus of care received in the postpartum period. In North Carolina, as part of a prospective cohort study, Ferrari et al (2010) assessed clinician advice regarding postpartum weight-loss and PA in women (n=688) at three months postpartum (296). In that study, the majority of women reported receiving no weight-loss (89%) or PA advice (77%) during the postpartum period (296). This lack of received advice does not necessarily reflect a new mother’s level of interest or motivation in wanting to lose weight. For example, in a study of 179 women at four months postpartum, approximately half (53%) of normal weight women, 79% of overweight women and 81% of obese women reported plans to seek weight-loss information, despite the fact that 85% of the women received no such information from healthcare providers (275). Moreover, many women have been found to report that they perceived their weight as less important during pregnancy compared with following childbirth (279, 284, 298), and that they are more motivated to address their weight postnatally (298). This is an interesting observation given that women in this study received weight advice much less frequently during the postpartum period compared with during pregnancy.

Despite a very large proportion of women in this study reporting having received healthy eating advice during pregnancy, just over half were meeting guidelines for fruit intake and only a very small proportion were meeting guidelines for vegetable intake. Similar results were found in a much smaller Australian study (n=58) where just four percent of women met guidelines for vegetable intake during pregnancy (425). Documented poor dietary intakes during pregnancy are common and multiple studies have found that women do not follow dietary guidelines during pregnancy (430, 500). For example, results from the ALSWH showed that none of the pregnant women included in the study (n=606) met recommendations for all food groups (425, 501). Similarly, in the UK the Southampton women’s survey (n=1490) found that almost half
of all women (45%) in early pregnancy did not meet recommended levels of vitamins (425, 502). This is concerning as poor nutrition during pregnancy has been linked with birth defects (430, 503), preterm delivery (430, 467), SGA infants (430, 504) and PPWR (155, 430).

Healthcare providers who have repeated contact with women throughout pregnancy have been regarded as being central to providing education and supporting women’s intentions towards achieving healthy behavior (388, 425). The literature supports the proposition that information provided by health professionals has a greater positive influence on women’s dietary change than information obtained from other sources (47, 48). However, when dietary advice was provided to women in this study there was no association found between the advice received and whether women were meeting guidelines for intake of fruit and vegetables, soft drinks or non-core snack foods. This might indicate that the advice provided to women was not specifically focused on optimising fruit and vegetable intake or on reducing energy dense foods, but rather focused on other issues such as food safety or ensuring adequate intake of folate intake, for example. Alternately, the emphasis on healthy eating advice might not have been as great as information provided regarding smoking cessation or alcohol intake, or generally speaking, women may be more receptive to such advice, rather than advice to eat more healthily. For example, the Southampton Women’s Health Survey found that pregnant women more easily followed recommendations for quitting smoking and reducing alcohol intake than recommendations to increase fruit and vegetable intake (425, 502).

Compared with during pregnancy, fewer women reported receiving advice for healthy eating during the postpartum period in this study. Far less is known about dietary habits of women during the postpartum period compared with during pregnancy and findings of existing studies have varied. One study found that dietary patterns in non-pregnant women remained reasonably stable over a two year period (505). Elsewhere, by six months postpartum dietary intake has been shown not to change significantly from pre-conception or from during pregnancy (227). In contrast, some studies have shown that diet quality is suboptimal for women during the postpartum period (76, 259, 495, 506, 507) with women discontinuing the healthy eating behaviours they may have adopted during pregnancy (77, 259, 507).

Regardless, during the postpartum period, women encounter many unique lifestyle adjustments and the period of change, particularly for first time mothers can present many barriers to making healthy lifestyle choices (275). Strategies which aim to promote healthy eating must
therefore be conducive to the busy lives of new mothers and might consider implementing approaches which coincide with promoting healthy infant dietary habits. For example, at around six months postpartum, when newborns transition to eating solid foods, women might be more motivated and more receptive to adopting healthy dietary habits themselves, alongside ensuring their children are being given the best opportunity to consume a healthy diet. It may be a more suitable time in which to engage with women for their own healthy eating, as opposed to the earlier months following childbirth (three months) as was the case for this study. Future research is needed to assess the potential effectiveness of such an approach.

Physical activity has been shown to be a critical influence on maternal weight (508) and inversely predicts PPWR 12 months after childbirth (161, 508). Women who meet guidelines for LTPA during the postpartum period have been shown to retain less weight six years postpartum than those who do not (509). However, few women in Australia, either during or following pregnancy, have been found to meet PA recommendations (255, 508, 510). Yet the results from our study showed that approximately two thirds of women were meeting PA recommendations based on 150 minutes per week over five or more sessions. This may in part be explained by women in this study engaging in high durations of walking. Walking has been found to be the most common form of exercise for new mothers (511). Postpartum interventions which have utilised PA have more frequently used walking to promote activity during the postpartum period, compared with other activities (512).

A recent systematic review of interventions during the postpartum period targeting postpartum weight loss via PA programs (512) found that of the eleven included studies, six studies strongly recommended walking as a suitable and successful form of PA for new mothers (512). As walking is functional, low cost and low risk (512) it is also a highly suitable activity for new mothers who are often faced with time restraints caused by the unpredictable challenges of motherhood. Walking offers a flexible approach to PA during the postpartum period whilst also having potential to positively impact maternal health. For example, in the US, a prospective randomised intervention study conducted by Davenport et al (326) examined the effect of postpartum exercise intensity on chronic disease risk factors. Following a 16 week intervention which implemented a control group and two exercise groups, defined by either low or moderate intensity walking for at least 25 min on three to four days per week, risk factors for chronic disease, including BMI, were significantly lower for women in the intervention groups compared with women in the control group (326). Furthermore, there was no additional
benefit seen for women in the higher intensity walking group. This suggests that even low intensity walking on most days of the week can be beneficial for the health of a new mother during the postpartum period.

However, of concern is that almost half of the women in this study reported that they had not received advice about PA by three months postpartum. Elsewhere, advice from healthcare providers during the postpartum period regarding PA has also been found to be inconsistent, with many women reporting having not received advice to be physically active (296, 493, 513). This is despite IOM recommendations, for example, that PA counselling be included in postpartum care for all women (514) regardless of weight status. Clearly a more rigorous approach to promoting PA following childbirth is needed to reduce the long term risk for overweight and obesity associated with PPWR and optimise maternal health.

In addition, sedentary behaviour has been regarded as an important determinant of health, independent of PA (515). Women have been described as being at high risk for sedentary lifestyles during pregnancy and following childbirth (516), making this an important and relevant factor to assess across the perinatal period. Although this study has provided some useful insight into patterns of TV/DVD/video time in new mothers, it is not surprising that there was no association between PA advice with reduced TV/DVD/video time observed. Provision of more specific advice to reduce sedentary time, rather than merely to increase PA would likely be required in order for advice to be influential.

Whilst this chapter has helped identify a major gap in the frequency of provision of weight, diet and PA advice during and following pregnancy, it is important to acknowledge that many barriers to provision of such advice have previously been identified across a wide range of practitioners, in the previous chapter as well as via other studies. In the previous chapter, for example, GPs frequently acknowledged that limited time and resources were major hindrances to management of GWG. Elsewhere, barriers identified have included lack of time (251, 313, 409, 517), lack of resources (251, 279), providers’ lack of knowledge (277, 377, 430, 498), or a reluctance to broach the topic of weight as a result of sensitivities of overweight and obese women in particular (292, 518).

More specifically, during the postpartum period face-to-face healthcare provider and patient contact occurs on fewer occasions, compared with during pregnancy, which is likely to in part
explain why women received advice less frequently, overall, in this study. Independent of the many barriers faced by healthcare providers, such as those outlined above, is the reduced opportunity for healthcare providers to adequately engage women in advice regarding healthy weight, diet and PA.

It is encouraging that healthcare providers themselves have previously acknowledged the need for lifestyle interventions to assist in promoting healthy maternal weight gain during pregnancy and following childbirth (299, 519). For example, in the US, Stotland et al (277) conducted several focus groups with obstetricians, gynaecologists, midwives and nurse practitioners, and found that the clinicians acknowledged GWG, nutrition and PA as being important topics with great potential to impact on a woman’s health and the health of her baby (277). From a public health perspective there appears to be a need to support healthcare providers and reach wide populations conveniently and cost-effectively. These are important considerations for future management of maternal weight across the perinatal period. Therefore, implementation of alternate supportive strategies such as healthy lifestyle intervention programs may be promising approaches for assisting women in their attainment of healthy weight gains and healthy lifestyle behaviours.

Many women entering pregnancy are already overweight or obese (41, 42) and almost half of all women exceed recommendations for GWG. Therefore, future supportive strategies to assist women in attaining healthy weight gain and healthy diet and PA behaviours during pregnancy are no doubt needed. However, the postpartum period might be considered an underutilised period, to an even greater extent, based on the findings from this study and from studies elsewhere regarding provision of support following childbirth (275, 296). In addition, with almost 50% of pregnancies being unplanned (316), a woman’s first pregnancy may be a challenging time to intervene for healthy weight attainment. As such, the postpartum period presents as an appropriate and important window of opportunity for provision of additional support.

This study has provided valuable insight into the frequency of advice women receive from their antenatal healthcare provider, and has assisted with identifying opportunities for future provision of support. Importantly, in this study, regardless of how frequently advice was received, it did not influence women to achieve a healthy weight, healthy diet, increased PA or reduced sedentary behavior. Therefore, rather than provision of advice, supportive strategies
such as lifestyle interventions may be more successful in engaging new mothers to be healthy. To date, fewer intervention studies aimed at promoting healthy maternal weight have been conducted during the postpartum period, compared with during pregnancy (Chapter 2) (2.10). In addition, the postpartum period has been identified as a stage within which many women want to lose weight (67, 199). Although few insights to date have been offered into best supportive strategies for women in their attainment of healthy postpartum weight, those which include both diet and PA as part of their component have been consistently found to be more successful than those which include only one of these components (250, 417, 512).

### 4.6 Strengths & limitations

This study is one of the first of its kind to assess provision of support received by first time mothers both during pregnancy and following childbirth. It is unique in that it has provided detail regarding not only frequency of weight related advice, but also provision of both diet and PA advice and an assessment of associations of advice received with healthy behaviour outcomes. In addition, postpartum anthropometric data was objectively measured and previously validated measures were used to assess both maternal diet and PA outcomes.

A main limitation of this study was the inability to determine what specific advice regarding weight, diet or PA was provided to women. Provision of non-specific advice by healthcare providers in this study may have been one reason why no associations with advice and maternal weight or behaviours was seen, yet this is unable to be determined. Future studies could seek to more clearly describe this level of detail to evaluate the influence of the type of information provided to women. Further, TV/DVD/video time was used as a proxy for sedentary behaviour in this study. Therefore it is likely that total sedentary time was much higher than reported in this sample of women, whereby activities such as sitting at the computer or engaging mobile devices such as tablet computers, iPads or smartphones could be expected to contribute to overall sedentary time but were not taken into account. Future research might seek to obtain a more detailed assessment of overall sedentary behaviour in new mothers.

Despite both valid and reliable tools being used to measure diet and PA, these methods do rely on self-reported data which acknowledged elsewhere can have some reduced accuracy and be prone to response bias, including reported socially desirable dietary intakes (520, 521) and levels of PA (522). Finally, this sample of women was predominately highly educated and
over half of the sample had moderate to high household income, limiting generalisibility of the results.

4.7 Conclusion & implications

This study showed that despite women being heavier on average, in the months following childbirth compared to pre-pregnancy, weight, diet and PA advice was provided less frequently following childbirth than during pregnancy. Moreover, healthcare provider advice was shown not to be associated with maternal weight or healthy lifestyle behaviours during pregnancy or following childbirth. Additional investigation is required to identify why the advice being provided is not supporting women to attain or maintain a healthy weight, eat a healthy diet and be sufficiently active to positively support their own health. Further studies are needed to assess effective forms of healthcare provider engagement of women’s weight during the postpartum period. More intensive support than healthcare provider advice currently being provided is likely required.

The period following childbirth is a time which is highly influential in terms of the mother’s future weight, both for subsequent pregnancies and her weight and health status in the long term. This period presents a key opportunity for the delivery of weight-focused interventions in a population vulnerable to excessive weight gain (259). As such, the following chapter introduces the mums Online, Lifestyle, Nutrition & Exercise (OnLiNE) pilot intervention study targeting first time mothers during the postpartum period. The ‘mums OnLiNE’ study is a supportive program aimed at promoting healthy maternal weight, diet and PA behaviours. Rationale for the intervention study and the methodology employed are described in the following chapter.
Chapter 5
The mums OnLiNE (Online, Lifestyle, Nutrition & Exercise) pilot intervention study: Methodology and results

5.1 Introduction

Previous chapters have provided a foundation for the design and implementation of the current study, the mums OnLiNE pilot intervention study. The review of literature presented in Chapter 2 and the results presented in Chapter 3 (Study 1) and Chapter 4 (Study 2) have assisted in identifying a gap in the current management of maternal weight across the perinatal period and in the provision of advice from antenatal healthcare providers regarding weight, diet and PA.

As outlined in previous chapters, PPWR has implications for weight related health of the mother and the offspring, in both the short and long term. Increased BMI from one pregnancy to the next is associated with increased risk of multiple serious obstetric (42, 96, 106, 119, 121-124, 138, 523) and neonatal (139-146) outcomes. Further, weight retention at 12 months postpartum has been found to predict maternal overweight 15 years later (205) and thus is likely to contribute to the development of maternal obesity and its associated morbidity (16, 207, 372). Weight retention following pregnancy might be particularly harmful to women as it tends to be centrally rather than peripherally deposited (218-220, 254), increasing risk for the development of CVD (220, 254, 524).

The postpartum period has been described as an ideal stage in which to engage with women in planning weight self–management behaviours (275). Women have been reported to want to lose weight following childbirth (2, 450, 525) and have reported higher motivation for weight-loss during the postpartum compared with during pregnancy (37). Yet, modest insight to date has been offered from the scientific literature into the most supportive strategies for women in their attainment of a healthy postpartum weight. Few interventions have been able to successfully limit PPWR and improve diet and PA habits of women as reported in Chapter 2 (Part two). A lack of consistency in successful intervention outcomes targeting maternal weight and healthy lifestyle behaviours has also been identified. As such, there is a need for innovative, broad reach approaches which aim to address healthy lifestyle behaviours during this important life stage (320).
Ideally, interventions would include combined diet and PA components as well as provision of individual support or individualised treatment, as combined approaches have been shown to more likely be effective in reducing PPWR than otherwise (250, 270, 322, 324-327, 329). Intervention delivery should be responsive to the unique lifestyle of a new mother. For example, whilst new mothers have been previously found to be unwilling to attend weekly group meetings, even when child support was readily available (322), home-based interventions may provide a less burdensome and ultimately more engaging approach than clinic-based attendance.

As outlined in Chapter 2 (2.10), coupled with the provision of home-based support, interventions delivered via email, telephone, or the internet might be even more practical than traditional face-to-face methods. In many instances these methods have been shown to be cost-effective (526, 527) with the ability to deliver key information to wide and diverse populations (335, 526, 528). Such modes of delivery for weight-loss support have been successful when implemented as part of interventions in the non-obstetric population (335-337). Moreover, online weight management programs have the potential to minimise participant burden associated with group counselling or clinic visits (350, 351) and have been found to be as successful as traditional face-to-face counselling for short term weight-loss (352). Despite these findings such approaches in this population have rarely been utilised.

Hence, the mums OnLiNE study (Study 3 of the thesis) was designed and implemented following identification of major gaps in the existing literature, with the intention to build on learnings from the review of previous intervention studies targeting PPWR and promoting healthy diet and PA behaviours following childbirth (417). This chapter describes the methodology of the mums OnLiNE pilot intervention study, reports the results of the intervention and provides a detailed discussion of the major study findings.

5.2 Aims & hypothesis

Broadly, the aim of the mums OnLiNE intervention was to assess whether a nine month, online healthy lifestyle intervention, supplemented with one-on-one telephone counselling and group support would assist first time mothers in limiting PPWR and improving diet, PA, sedentary behaviours and self-efficacy during the postpartum period.
Specifically, the aims of this study were to assess the efficacy of the intervention by presenting and analysing change in the following outcomes from baseline to intervention completion, for the intervention (I) group, relative to two control groups (C1) and (C2):

- anthropometry (PPWR, WC)
- daily dietary intake
- weekly PA
- daily sedentary behaviour
- diet and PA self-efficacy

It was hypothesised that upon completion of the nine month intervention, (I) group mothers would have:

- reduced PPWR
- reduced WC
- improved dietary intakes
- increased engagement in PA
- reduced sedentary behaviour and
- improved self-efficacy to achieve targeted diet and PA behaviours

5.3 Methods

5.3.1 Participants

The mums OnLiNE pilot intervention study was nested within the InFANT Extend RCT. An in-depth description of the process of recruiting women to the InFANT Extend study was provided in the Chapter 4 (4.3.1). Ethics for the mums OnLiNE pilot intervention was approved by the Deakin University Human Research Ethics Committee (modification of 2011-029 (2007-175) (11/02/2011)).

Section 4.4.1 of the previous chapter reported a 90% uptake, whereby 477 women were recruited to the InFANT Extend RCT. However, two women provided consent but did not complete baseline assessments. This left 475 women enrolled. These 475 women, came from
31 groups (n=232 parent-newborn pairs) in the control arm of InFANT Extend and 31 groups (n=243 parent-newborn pairs) in the intervention arm, from seven LGAs throughout Victoria. These details are presented in Figure 5.1.
**Figure 5.1** Women enrolled in the InFANT Extend RCT from which the mums OnLiNE study participants were drawn.

**InFANT Extend RCT**

(n=475)

**Control arm**

First time parent groups enrolled per LGA

- Casey (9)
- Darebin (6)
- Geelong (6)
- Hobson’s Bay (4)
- Maroondah (3)
- Melton (2)
- Surfcoast (1)

Total: 31 groups

**Intervention arm**

First time parent groups enrolled per LGA

- Casey (9)
- Darebin (6)
- Geelong (6)
- Hobson’s Bay (4)
- Maroondah (3)
- Melton (2)
- Surfcoast (1)

Total: 31 groups

**Number of women enrolled in each first time parent group**

**Control arm**

- Casey (n=65)
- Darebin (n=48)
- Geelong (n=41)
- Hobson’s Bay (n=34)
- Maroondah (n=21)
- Melton (n=16)
- Surfcoast (n=7)

Total (n=232)

**Intervention arm**

- Casey (n=64)
- Darebin (n=44)
- Geelong (n=52)
- Hobson’s Bay (n=46)
- Maroondah (n=21)
- Melton (n=13)
- Surfcoast (n=3)

Total (n=243)

**mums OnLiNE pilot intervention**

Study sample drawn from participants of InFANT Extend intervention arm
The sample of women recruited to the mums OnLiNE pilot intervention was drawn from the 31 first time parent groups allocated to the intervention arm of the InFANT Extend RCT as shown in Figure 5.1. Recruitment for the mums OnLiNE pilot intervention study commenced in June 2011 and concluded in March 2012. As the recruitment and intervention delivery for InFANT Extend were staggered, spanning over 12 months, this was also the case for the mums OnLiNE study recruitment.

5.3.2 Eligibility

An overview of the recruitment stages with the number of women approached at each stage, is presented in Figure 5.2. In total, 20 women from the InFANT Extend study, from two parent groups, were not approached. These two InFANT Extend groups had already completed their fourth InFANT Extend session and were more than 12 months postpartum, making it too far postpartum for these women to be recruited. As outlined in Chapter 4 (4.4.1), some women had non-singleton pregnancies (n=6 total; n=3 intervention arm), some women did not provide detail regarding parity (n=6 total; n=4 intervention arm) and a further 15 women in total (n=8 intervention arm) were not first time mothers. These women were not eligible for recruitment to the mums OnLiNE intervention. In total 208 women were deemed eligible for recruitment into the mums OnLiNE study.

Of the 208 eligible mothers, written consent to take part in the study was received from 54 (26%) mothers. Whilst many previous intervention studies aimed at limiting PPWR through diet and/or PA programs have not reported recruitment response rates (270, 322, 324-326, 329, 333), the small sample sizes evident across those studies might reflect difficulty faced in recruiting first time mothers. New mothers are often faced with untried challenges accompanied by a shift in focus from their own lifestyle, to caring for their new infant. This was anticipated to be one potential barrier to recruitment of mothers to a program aimed at addressing their own health and as such the recruitment process was rigorous and multiple recruitment strategies (outlined below) were employed to maximise engagement. Women consenting to take part in the mums OnLiNE intervention were thus enrolled simultaneously in both studies; the InFANT Extend RCT and the mums OnLiNE intervention.
**Figure 5.2** Overview of the eligibility and recruitment to the mums OnLiNE pilot intervention study

- **InFANT Extend RCT** (n=475)
  - **Control Arm** (n=232) (31 first time parent groups)
  - **Intervention Arm** (n=243) (31 first time parent groups)
  - **Ineligible** (n=35)
    - Too far postpartum (n=20)
    - Non singleton pregnancies (n=3)
    - No detail regarding parity (n=4)
    - Non first time mothers (n=8)

- **Number of women eligible for recruitment to the mums OnLiNE study**
  - (n=208) (29 first time parent groups)

- **mums OnLiNE total consent received**
  - (n=54) (22 first time parent groups)
Mothers were recruited to the mums OnLiNE intervention at their third of six InFANT Extend intervention sessions. They were on average, nine months postpartum at that session. Assessment of previous intervention studies focused on limiting PPWR shows that the stage of recruitment of mothers during the postpartum period varies across studies (270, 322, 324-327, 329, 330, 333, 334). Studies shown to be successful in promoting postpartum weight-loss have recruited mothers from 24 hours post delivery (329) up to six months (270) or 12 months postpartum (270, 322). By nine months postpartum infant sleep habits and feeding practices may likely better established than during first three to six months of the new infant’s life. In informing timing of recruitment to the mums OnLiNE intervention, it was hypothesised that by nine months postpartum, mother’s motivation toward addressing their own dietary and PA behaviours may have been higher than in the early months following childbirth when much focus is on the newborn.

5.3.3 Matched control groups

The control group of the InFANT Extend RCT and the sample of women who were from the intervention arm of InFANT Extend, but who did not elect to participate in the mums OnLiNE intervention, formed the two comparison (control) groups (C1 and C2). Assessment of maternal outcomes described in section 5.7 was reported both within and between three groups; the mums OnLiNE intervention group (I), (C1) and (C2).

An overview of the stages of sampling for the two control groups and participation in the mums OnLiNE study is presented in Figure 5.3. A total of 358 women from the original InFANT Extend sample of 448 women (80%) completed the survey at nine months postpartum. Baseline data for the mums OnLiNE intervention was drawn from this survey. Of the 358 women, 135 women were excluded from the sampling due to incomplete anthropometric data, 21 women were excluded due to becoming pregnant and data for the 40 women already enrolled in the intervention was excluded from this stage of sampling. This left 162 women in a total sample from where the control group 1 (C1) and control group 2 (C2) sub-samples were drawn for the mums OnLiNE comparison groups. Women included in the (C1) group (n=60 from 24 groups) for were drawn from the control arm of the InFANT Extend RCT and women from the (C2) group (n=60 from 21 groups) were drawn from the intervention arm of InFANT Extend.
Figure 5.3 Overview sampling steps for the two control groups in the mums OnLiNE intervention

Completed 9 month InFANT Extend RCT survey (Baseline mums OnLiNE survey)
(n=358) (62 groups)

Excluded
Pregnant (n=21) Missing WC measures (n=135)

InFANT Extend control group (n=99)

InFANT Extend intervention group (n=103)

mums OnLiNE intervention sample (n=40)

Matched sample
mums OnLiNE Control group (C1)
(n=60) (24 groups)

Matched sample
mums OnLiNE Control group (C2)
(n=60) (21 groups)

Withdrawn pregnant (n=12)

Withdrawn pregnant (n=17)

(C1) Enrolled at intervention completion (n=48) (23 groups)

(C2) Enrolled at intervention completion (n=43) (20 groups)
A slightly larger (relative to the mums OnLiNE intervention group) sample of 60 women for each mums OnLiNE comparison group was generated to account for potential attrition (e.g. due to women becoming pregnant, which was observed in the mums OnLiNE intervention group sample over the study period). Sampling was conducted using SPSS statistical package version 21.

Once the control group samples were generated, t-tests were conducted to confirm non-significant differences between mean BMI at baseline and mean education levels across all three groups to ensure groups were matched on true characteristics. T-tests ensured the mean values for both maternal BMI and education were not significantly different (p>0.05). Large RCTs (529, 530) and prospective cohort studies (531) which have assessed weight change in adult women have consistently adjusted for baseline BMI. Although pre-pregnancy BMI has been documented previously as being a predictor of PPWR (37, 209, 249, 532), samples were matched in the current study on baseline BMI as a continuous variable. The postpartum period is a time whereby women are not only vulnerable to weight retention but are also susceptible to weight gain (250, 254). In addition, pre-pregnancy BMI was calculated from self-reported weight which is less accurate. Therefore baseline BMI was considered more relevant as a potential confounding factor for PPWR, anthropometric and behavioural outcomes. Furthermore, unlike many previous interventions aimed at reducing PPWR (270, 324-326, 330), and studies assessing change in weight in female adult populations (339, 533), this study did not set BMI as part of the inclusion criteria. Therefore matching groups on baseline BMI eliminated BMI as a potential confounding factor in assessing change in anthropometric outcomes.

Maternal education, when assessed as part of socioeconomic status, has previously been inversely associated with weight retention (534-536). For instance, Althuizen et al. (2011) found that Dutch women who had not completed post high school education had increased odds of retaining ≥ 5kg by 12 months postpartum (537). Elsewhere, Østbye et al. (2011) found that in overweight and obese women, those who were more highly educated (having obtained a university degree) were more likely to lose weight during the postpartum period, compared to less educated women (249).
5.3.4 Recruitment process

Each step (1-3) of the recruitment process and the strategies employed for approaching women to take part in the mums OnLiNE study are outlined in detail below. An overview of the entire recruitment process is presented in Figure 5.4.

Step 1.

Facebook post

New mothers have been previously referred to as “a population sub-group immersed in new age media” (86). Specifically, Bartholomew et al. (538) found that women’s Facebook use increased during the transition into motherhood and the majority of women visited the site daily (263, 538). Since the major function of Facebook is to facilitate communication (263) this was a timely and opportune recruitment approach. Mothers approached to participate in the mums OnLiNE program via this method were existing members of Facebook and were already receiving information as part of the InFANT Extend intervention via this means of delivery. Once a mother had become “friends’ with InFANT Extend, she was assigned to a private Facebook group for herself and the other members of her first time mothers group. An initial recruitment message was posted to the wall of each private Facebook group prior to the more formal written invitation (outlined below) being sent by post. The message was posted to Facebook approximately two weeks prior to the third InFANT Extend session and appeared as follows:

![Infant Time]

Hi mums! Keep an eye out for your invitation to join mums OnLiNE - an exciting new addition to INFANT - designed for first time mums! More information should arrive in the mail soon!

Like · Comment · Unfollow Post · November 28, 2012 at 7:33am

☑ Seen by 1

ATOM

Write a comment...
Invitation via mail

Following the Facebook post mothers were sent written information in the form of a plain language statement and consent form and an invitation to participate in the mums OnLiNE program. Information was sent via mail to all women prior to their upcoming third InFANT Extend session. They were asked to hand their signed consent form to the facilitator at the upcoming session or if they were unable to attend the session in person, they were asked to return their consent form via mail if they agreed to take part. Once consent forms were received, mothers were telephoned to schedule their first one-on-one telephone counselling call with the PhD candidate (a dietitian) and begin the intervention.

Step 2.

Facebook prompt and email reminder

A reminder prompt was posted to the wall of each private Facebook group approximately two weeks after the initial post and appeared as follows:

![Facebook post]

A further two weeks later, mothers were sent a reminder email which read as the above Facebook post and which reminded mothers to return their signed consent forms if they decided to take part in the program or to raise any questions about the program.
Step 3.

Face-to-face recruitment visit

In an effort to maximise intervention uptake, a face-to-face visit to a proportion of the groups who had not yet approached their third InFANT Extend session was conducted. They were visited earlier, at their second InFANT Extend session, to more rigorously promote the mums OnLiNE program. Seven groups (n=59 women) were visited in person by the candidate at their second InFANT Extend session. This involved a ten minute overview of the mums OnLiNE intervention and distribution of the written information and an invitation to take part. Mothers were given the opportunity to ask questions about the mums OnLiNE program. They were asked to return their signed consent in a supplied reply-paid envelope via mail. When consent forms were received, women were telephoned as outlined above in step 1. Women in these groups also received the recruitment strategies described in steps 1 and 2 above, as they approached their third InFANT Extend session.

Last chance mail out

A total of 190 mothers from 29 groups who had not responded to earlier invitations to participate were sent a duplicate of the initial invitation they had received in the mail, as a last attempt to recruit women to the study. They were asked to return signed consent forms in a supplied reply-paid envelope should they choose to take part. They were telephoned to schedule their first one-on-one phone call as outlined above in step 1, as soon as the consent form was received.
Figure 5.4 Overview of the recruitment strategies employed for the mums OnLiNE pilot intervention study

InFANT Extend RCT  
(n=475)

Intervention arm  
(n=223)  
(29 first time parent groups)

Step 1.  
Facebook post  
(n=100)  
(26 groups)  
No Facebook group  
(n=17)  
(3 groups)  
Mailed invitation  
(n=223)  
(29 groups)

Step 2.  
Facebook prompt  
(n=100)  
(26 groups)  
Email reminder  
(n=207)  
(27 groups)  
No email address provided  
(n=16)

Step 3.  
Face-to-face recruitment visit  
(n=59)  
(7 groups)  
Last chance mail out  
(n=190)  
(29 groups)

Eligibility  
Ineligible  
(n=35)  
Eligible  
(n=208)

Consent  
Consent provided before last chance mail out  
(n=42)  
Consent provided following last chance mail out  
(n=12)

mums OnLiNE intervention  
Total consent received  
(n=54)  
(22 groups)
5.4 Intervention

Theory-based interventions have been described as offering multiple advantages over atheoretical interventions (331, 332), including reduced intervention dosage and increased likelihood of behaviour change (331, 332). The theoretical framework which underpinned this intervention was Bandura’s social cognitive theory (SCT) (539), with evidence-based behaviour change components including self-monitoring and feedback, goal setting, individual and group support and perceived barriers. The SCT is one of the most widely utilised theoretical frameworks for promoting health behaviours (540) and successful weight-loss interventions have previously employed key elements of SCT in their design, (335, 350, 362, 541).

5.4.1 Intervention overview

The mums OnLiNE pilot intervention study was delivered over a nine month period. Following an initial phone call to schedule their first one-on-one telephone counselling call, women received written material in the mail. Throughout the nine month intervention period women received access to a commercial, web-based program (CalorieKing) that aimed to improve diet and PA behaviours and in turn facilitate weight-loss. Participants used this program freely throughout the nine month study period at their discretion. The program could be accessed online and during the course of the study also became available as an iPhone application (app). Women received three one-on-one telephone counselling calls, scheduled approximately at baseline, at three months and at six months post recruitment. The first phone call was scheduled to be approximately 30-45 minutes in length while the two subsequent phone calls were scheduled to last approximately 15 minutes each. In addition, throughout the intervention period, the provision of group support was provided to all women with optional access to an online blog. A timeline of intervention components delivered over the nine month intervention period is presented in Figure 5.5.
Figure 5.5 Timeline of intervention components and delivery during the mums OnLiNE pilot intervention study

Written material:
(1) DHA PA recommendations
(2) pedometer
(3) tape measure for self-monitoring WC
(4) SMART goal setting chart
(5) CalorieKing calorie counting book
(6) CalorieKing user manual

Individual telephone support call
(#1) (45 mins)

Baseline 3 months 6 months 9 months
5.4.2 Intervention content

A review of efficacious technology-based weight-loss interventions conducted by Khaylis et al (2010) suggested that for any technology driven weight-loss intervention, self-monitoring, counsellor feedback, social support, use of a structured program and use of an individually tailored program were crucial to intervention success (362). These components are also consistent with those described above as important elements of the SCT. Goal setting has been shown to be a promising approach to behaviour change across many health focused interventions (542-544). Specifically, SMART (Specific, Measureable, Attainable, Realistic, Time-related) goals have been a widely accepted application for goal setting (545). The SMART goal approach has been shown to be successful for promoting both nutrition and PA behaviour change (546-549).

Likewise, the inclusion of self-monitoring has been referred to as the cornerstone of behavioural weight-loss interventions (460, 550, 551). A recent systematic review of diet, exercise and weight self-monitoring for the intention of weight-loss showed that across 22 studies included in the review, a significant association was found between self-monitoring and weight-loss (550). Despite methodological limitations of self-reporting across many of the studies, as well as a vast differences in methods used to record and self-monitor progress, the authors concluded that there was ample evidence for the consistent, positive relationship between self-monitoring of diet, PA and weight-monitoring with successful weight-loss outcomes (550). The components shown to be successful for health behaviour change discussed above have been addressed through the intervention content (1-4), which is provided in detail below.

1. CalorieKing online commercial program

Reviews of web-based weight-loss interventions have identified the potential of these programs to achieve significant weight-loss (339, 352, 353, 356, 552). Moreover, use of an online program similar to that of the CalorieKing program was found to be effective for weight-loss over 12 and 52 weeks when used as part of an intervention in a large cohort of predominately obese, Australian women (339). Specifically it has been reported that the internet serves the needs of mothers better than any alternate form of media (553) and as such, an online approach to intervention delivery would seem highly appropriate for this population. The CalorieKing
program is self-directed and encompasses evidence based weight management strategies in setting daily energy (kcal) targets, based on the woman’s height, weight, PA levels and breastfeeding status. Daily energy targets were designed to facilitate weight-loss to meet a pre-determined goals set by the participant upon discussion and advice from the dietitian during the first phone call. Women were encouraged to set long-term weight targets. Short-term weight goals were negotiated with the dietitian to facilitate meeting a future healthy BMI and progressively achieving smaller weight goals towards the long-term weight target.

The main feature of the CalorieKing program is an online diary, enabling automatic tracking of energy intake and expenditure. Women were encouraged to enter daily food and fluid consumption and daily exercise. As the information is entered, the program progressively calculates the remaining proportion of the pre-set energy target allocated for that day. The program includes a large database of foods regularly available for consumption in Australia which matches the list of foods in the CalorieKing pocket book given to women as part of the written material at baseline. In addition, walking information could be added through selecting the type of activity and the duration or the number of daily steps undertaken, measured by the participant electing to wear a pedometer.

Women were encouraged to use the self-monitoring tools including recording weight and WC measures regularly. The program was then able to record anthropometric measures as well as daily steps, energy intake and expenditure in charts and reports to provide women with regular feedback related to goal setting and progress. In addition, the program features online recipes, factsheets, newsletters and the option of participating in live chats and online forums which were available for women to use as they wished.

Part-way through the intervention, CalorieKing released an iPhone app which allows the user to track daily diet and exercise activities and set weight and energy targets in the same way as for the website, outlined above. The app is able to provide women with charts and reports for regular feedback related to goal setting and progress. The app does not sync with the CalorieKing website, meaning that any information which had previously been entered into the website (e.g. height and weight) needed to be re-entered into the app once it was installed. Women who chose to install the app were required to pay $4.49 to download this from the iTunes store. There was no funding provided to women to download the app, yet prompts on
the website directed women to the iTunes store if they wished to download and pay for it at their own cost.

2. Written material and other resources

Following an initial phone call to schedule their first one-on-one telephone counselling call, women received written material in the mail upon enrolling in the intervention (Appendix 5). The resources were tailored to women but were informed by a previous intervention which used written material to accompany use of the CalorieKing program in a study conducted with adult males (554). That study showed significant weight-loss following the six month program for the participants in the group who received written material only as well as for the group who received the written resources and had access to the online CalorieKing program, compared to wait-list controls.

The materials provided included (1) The Department of Health and Ageing ‘An active way to better health’ brochure, outlining PA recommendations for Australian adults and practical strategies to meet PA guidelines; (2) a pedometer, if they had not already received one at an earlier stage as part of the InFANT Extend study; (3) a tape measure and guide for self-monitoring of WC; (4) a SMART goal setting chart for weight, PA and/or dietary related goals; (5) a CalorieKing pocket calorie counter book which included nutritional information for Australian food products; and (6) a detailed, step by step instruction manual to assist using the CalorieKing program. This information was discussed during the first one-on-one telephone counselling call.

3. Individual telephone support

Women received three one-on-one telephone calls with the dietitian, over the nine month intervention period. Interventions utilising telephone counselling rather than face-to-face methods may be an advantageous approach as they are relatively low cost and less burdensome to the participant (548). In particular, for new mothers facing frequent time constraints, telephone support was deemed more suitable than in-person counselling. This approach has been successful for delivery of behaviour change interventions such as encouraging multiple dietary changes (548, 549, 555). For women during the postpartum period, telephone support as a primary intervention component has promoted successful breastfeeding outcomes (365).
The aims of the first phone call were to introduce women to the mums OnLINE intervention, discuss content of the written diet and PA information, assist women in setting individual SMART goals related to weight, diet and/or PA and to provide women with clear instructions as to how to use the CalorieKing program. Assistance was provided to women in creating their online account for access to the website as well as their personal profile to then help determine weight goals and energy targets. The phone call was tailored specifically to the individual and was based on health coaching strategies whereby participants are assisted in integrating new knowledge into their personal behaviour change plans (556) in an effort to create immediate action and increase the likelihood of a healthy behaviour change (556).

The aim of the two, short, subsequent phone calls was to provide additional motivation and individually tailored support to women. Women briefly discussed their progress towards achieving their healthy lifestyle goals with the dietitian. Barriers encountered which may have hampered achieving goals and methods of overcoming these were also discussed. Goals were re-established based on whether or not the participant’s circumstances had changed (e.g. returning to work) or if past goals had been achieved. During the phone calls, women had the opportunity to ask for advice related to their own weight-loss, nutrition, PA habits and sedentary behaviours and practical strategies were recommended for the purpose of encouraging healthy lifestyle options.

4. Group blog

Blogging has previously been identified as a popular phenomenon among new mothers (363, 553) and in a study of 157 mothers McDaniel et al. found that frequency of blogging positively predicted feelings of connection to family and friends (363, 553). The mums OnLiNE blog was designed specifically to facilitate connection with the dietitian as well as to encourage social interaction with other mothers participating in the mums OnLiNE program. Women were given the opportunity to sign up for optional support provided by the blog, whereby they could post questions related to weight-loss, nutrition and/or PA which would be answered by the dietitian. The blog, monitored weekly, gave new mothers the opportunity to discuss their own goals and share their experiences throughout the mums OnLiNE program. Information such as healthy lifestyle tips were posted intermittently throughout the mums OnLiNE program.
5.5 Data collection processes

Baseline anthropometric (measured height and weight) and survey data for mothers enrolled in the mums OnLiNE pilot intervention study were extracted from data collected at the third InFANT Extend session, when women were approximately nine months postpartum. For those mothers who enrolled in the mums OnLiNE more than one month after the objective data collection, weight and WC were self-reported.

Baseline survey data for the mums OnLiNE program was drawn from the second of three surveys completed as part of the InFANT Extend program. This had been mailed to each participant two weeks prior to their third InFANT Extend group session and they returned it to the facilitator at the session. Those women who were unable to attend their third InFANT Extend session, were visited in their home for anthropometric data collection, as part of the InFANT Extend study. Women who chose to take up the mums OnLiNE program and who were one month or more past their InFANT Extend session at the time of starting the intervention self-reported anthropometric measures upon commencing the mums OnLiNE program during the first phone call.

Post intervention anthropometric and survey data for the mums OnLiNE program were extracted from the InFANT Extend survey and anthropometric measures taken at the final InFANT Extend group education session, when mothers were approximately 18 months postpartum. When mothers were unable to attend this final InFANT Extend session, they were visited in their homes for data collection as part of the InFANT Extend study. Women who had completed the mums OnLiNE program at least one month following their last InFANT Extend session were visited in their homes for both anthropometric and survey data collection.

5.6 Participant retention strategies

Retention rates have been shown to vary across lifestyle intervention studies aimed at reducing PPWR. Retention rates have ranged from 100% following an 11 day intervention program (327) to 53% at one year (270). Thus retention of mothers enrolled in the nine month mums OnLiNE intervention was an important consideration. Retention was likely enhanced by contact made to mothers frequently throughout their enrolment in the InFANT Extend study. As mothers participating in the mums OnLiNE intervention were already enrolled in the larger
InFANT Extend study and receiving small gifts as compensation of survey completion, this may have further promoted retention in the mums OnLiNE program. Retention in InFANT Extend was promoted by contact between InFANT Extend group sessions via Facebook posts, directing mothers to websites and material to promote healthy diet and PA behaviours for their children. Mothers also received quarterly newsletters, birthday and Christmas cards as part of the larger InFANT Extend study.

Simultaneous data collection with InFANT Extend data collection at nine months and 18 months postpartum aimed to assist the retention of participants. As an alternative, women would have had to complete additional surveys, which would likely have been burdensome. When women were unable to attend the final InFANT Extend group education session and have anthropometric measures taken, home visits were made at a time suitable to the mother. Women whose last InFANT Extend session did not coincide with the completion of the mums OnLiNE study were visited in their homes, where anthropometric data was taken and they completed the 18 month survey. These women received a $20.00 gift voucher as compensation for their additional time commitment.

It might also be expected that retention rates would be high through utilisation of one-on-one telephone support calls as part of mums OnLiNE intervention delivery, as has been observed in other telephone delivered interventions targeting weight-loss and health behaviour change (548, 557). Telephone support can facilitate rapport building with study participants (556) and as such may positively impact retention of participants enrolled in the mums OnLiNE program.

5.7 Measures

As outlined in section 5.5, assessment for anthropometry, diet and PA occurred at baseline and post intervention. Data collection time points and measures used are outlined in Figure 5.6. Detail regarding the methods employed to measure both the primary and secondary outcomes are outlined below. Assessment of maternal outcomes was reported both within and between three groups; the (I) group and two control groups (C1 and C2).
Primary outcomes

- Postpartum weight retention (PPWR) (kg)
- Waist circumference (WC) (cm)

Secondary outcomes

- Daily dietary intake (e.g. frequency of consumption of fruit and vegetables, and high energy snack foods)
- Weekly PA patterns (e.g. time spent walking, in moderate and/or vigorous physical activity)
- Daily sedentary behaviour (e.g. time spent sitting watching TV/DVDs/videos)
- Diet and PA self-efficacy (e.g. confidence to eat healthily or exercise in a variety of different circumstances)

5.7.1 Primary outcomes

Height, weight and WC of mothers were measured by trained research staff. Prior to commencement of data collection, research staff responsible for collecting anthropometric data completed a formal training workshop to ensure consistency in measurement techniques and adherence to data collection protocols. The training ensured inter- and intra-rater reliability of measurements of maternal height, weight and waist circumference. All equipment used for anthropometry measurements were calibrated prior to the beginning of the InFANT Extend intervention and approximately mid-way through the intervention.

Height and Weight

Height was measured using a Victor stadiometer. Two measurements were taken separately and were recorded to the nearest 0.1cm. If the two measurements disagreed by 0.5cm or more, a third measurement was taken and recorded. The average of the two or two closest height measurements of three, was used to calculate BMI. Weight in light clothing and with shoes removed was measured once using Tanita digital scales (Model 1582) and recorded to the nearest 0.01kg. Maternal BMI was calculated (weight (kg) / height (m)^2), and used to classify
participants according to World Health Organization and Australian National Health and Medical Research Council criteria as underweight (BMI < 18.5), healthy weight (BMI 18.5 to < 25.0), overweight (BMI 25.0 to < 30.0) or obese (BMI ≥ 30.0) (459, 460). Postpartum weight retention was calculated by those methods outlined in Chapter 4 (4.3.3).

**Waist circumference**

Although BMI is considered the ‘gold standard’ for identifying subjects at risk for excess adiposity and related adverse health outcomes (558), body fat distribution is also an important risk factor for obesity and chronic disease risk (558). As such, WC is frequently used as a measure of abdominal fat mass and is correlated with both subcutaneous and intra-abdominal adiposity (558). Measures of WC are important in this population group specifically, as weight retention as a result of pregnancy tends to centrally rather than peripherally deposited (218-220, 254), increasing the risk for development of cardiovascular disease (220, 254, 524). Waist circumference was measured using a Lufkin Executive Thinline tape measure (W606PM). Measurements were taken in light clothing with shoes removed. The participant assumed a relaxed position with arms folded across the chest. The measurement was taken at the end of a normal expiration. Two separate measurements were taken anteriorly, halfway between the lowest lateral portion of the ribcage and the iliac crest. Measurements were recorded to the nearest 0.1cm and the average of the two measurements was used.

When anthropometry was unable to be measured by trained researchers, mothers self-reported height, weight and WC. Self-reported measures are one of the most common ways to collect anthropometric data and have been shown to have advantages of being practical, convenient to administer and are a lower cost method compared with objective (measured) methods (461). Yet tools for self-report have been shown to exhibit multiple limitations (461). Results of several reviews comparing direct versus self-reported measures for assessing height, weight and BMI (461) show that height tends to be overestimated and weight and BMI underestimated (463, 464). As such, objectively measured anthropometry has been recommended to improve measurement precision (461) and these methods were used where possible for data collection in the mums OnLiNE pilot intervention study.
5.7.2 Secondary outcomes

**Dietary intake**

At baseline, dietary intake was assessed using a modified FFQ, adapted from the CCV Dietary DQES version 3.1 (468), which was previously described in Chapter 4 (4.3.3) (Appendix 4). The modified version consisted of 19 questions which assessed frequency of intake of different foods over the past month and past 12 months as well as usual intake of a number of different foods and beverages (Appendix 6, section B). At intervention completion, the CCV DQES version 3.1 (468) was used. Detail regarding the questionnaire format and measures was previously described in Chapter 4 (4.3.3).

Some inconsistencies in these two assessment tools were apparent and have been outlined in the limitations section of this chapter (5.10). Fruit intake was assessed at baseline with eight possible responses ranging from ‘I don’t eat fruit’ to ‘6 or more serves per day’. At follow up, there were also eight possible responses ranging from ‘none’ to ‘6 or more serves of fruit per day’. In both instances, a serving size guide was given to assist in quantification of intake. Responses were collapsed into three categories to eliminate response categories containing too few numbers of observations. Vegetable intake was assessed at baseline with eight possible responses ranging from ‘I don’t eat vegetables’ to 6 or more serves per day’. At follow up, there were nine possible responses ranging from ‘none’ to 7 or more serves of vegetables per day’. Responses were collapsed into four categories to eliminate response categories containing too few numbers of observations (e.g. no women reported consuming 7 or more serves of vegetables per day). At baseline, vegetable intake excluded potato intake whereas at follow up, potatoes were included in assessment of vegetable intake. These differences in assessment methods have been discussed in the limitation section of this chapter. Fruit and vegetable intake were compared with 2013 Australian adult recommendations for daily fruit and vegetable intake (514). It was important to assess fruit and vegetable intake in this sample of women, as both written material provided at baseline and individually tailored dietary advice was in line with the most up to date (2003) Dietary Guidelines for Australian Adults (473), which at the time of the intervention recommended to consume two serves of fruit and five serves of vegetables per day. As there were slight differences between the earlier recommendations and the updated 2013 Australian Dietary Guidelines (the latter version included legumes and beans in the definition of ‘vegetables’), recommendations of two serves of fruit and five serves of
vegetables per day (not including legumes or beans as ‘vegetables’) were used as a benchmark to ensure consistency with the information provided to women.

Frequency of intake of a sub-sample of non-core foods to compare at baseline and follow up were selected based on the food groups that best matched the baseline questionnaire and the follow up CCV’s FFQ. These were crisps, chocolate/lollies, cakes/biscuits and pies/sausage rolls. At follow up, intake of cakes/biscuits was assessed by two separate non-core food categories; ‘sweet biscuits’ and ‘cakes or sweet pastries’. For each respondent, the higher response to either ‘sweet biscuits’ or ‘cakes or sweet pastries’ was used as the final score for the newly formed, combined category ‘cakes/biscuits’. The categories needed to be combined to match the baseline category ‘cakes/biscuits’. At baseline, there were nine possible responses for each non-core food group ranging from ‘never or less than once per month’ to ‘6 or more times per day’. At follow up there were ten possible responses ranging from ‘never’ to ‘3 or more times per day’. Responses were collapsed into four combined categories to eliminate response categories containing too few numbers of observations.

**Physical activity**

Physical activity both at baseline and intervention completion was assessed using the Australian Institute of Health and Welfare’s AAS (474, 476). Detail regarding this tool has been previously described in Chapter 4 (4.3.3) (Appendix 3, section F). As previously outlined, the AAS has been shown to be both valid and reliable for use in Australian populations (476-478). Test-retest reliability has been deemed similar to the International Physical Activity Questionnaire (474, 476). Women were asked to estimate the total duration (number of times and total hours and minutes) they spent walking continuously (for at least 10 minutes) for recreation, exercise or to get from place to place, and being engaged in both vigorous and moderate PA which excluded household chores, gardening or yard work, in the week prior to completing the questionnaire. To avoid the possibility of errors due to over-reporting, any times greater than 840 min/week for a single type of activity were truncated to 840 min/week (14 hours) (474, 483). In addition, for any participant whose total time in all activities was greater than 1680 min/week (28 hours), this was truncated to 1680 min/week as per the survey protocol (474, 483). The methods described in Chapter 4 (4.3.3) were also employed to record and calculate total PA time (min/week), sufficient PA time (min/week), meeting PA recommendations and for classification of women as inactive.
Sedentary behaviour

The questionnaire assessed one marker of sedentary behaviour at both baseline and intervention completion. Sedentary behaviour was defined as time spent sitting, viewing television/DVD/videos (henceforth sedentary behavior is actually time ‘TV/DVD/video time’) as was the case for the definition of sedentary time described in Chapter 4 (4.3.3). Usual ‘TV/DVD/video’ time was assessed by two items included in the self-administered questionnaire (Appendix 3, section F). Women were asked to report the usual time (hours and minutes) on a weekday and separately on a weekend day, that they spent sitting watching TV or videos/DVDs. An average daily time (min/day) was calculated by summing the time reported for weekdays (multiplied by five (weekdays per week)) with the time reported for weekend days (multiplied by two (two weekend days per week)) and dividing that score by seven. Reported durations and total viewing time were truncated to 1080 min/day (18 hours) as per previous methodology employed for the earlier Melbourne InFANT trial (483).

Diet and physical activity self-efficacy

Diet related self-efficacy at both baseline and intervention completion was assessed from one survey question assessing perceived self confidence in making multiple healthy dietary choices in the next 12 months (Appendix 7). Participants rated their perceived confidence on a five point rating scale of ‘not at all confident’ to ‘extremely confident’ for various healthy dietary related practices. Physical activity related self-efficacy was evaluated from one survey item assessing perceived self confidence in making multiple PA choices in the next 12 months. Participants rated their perceived confidence on a 5-point rating scale of ‘not at all confident’ to ‘extremely confident’ for various PA-related practices. Responses for diet self-efficacy and PA self-efficacy at baseline and intervention completion were summed to give an overall self-efficacy score for each. A sub-set of dietary confidence items (eight items) were selected based on similarity with five responses ranging from ‘not at all confident’ to ‘extremely confident’. These responses were given a numerical score (1-5, where 1 was ‘not at all confident’) and treated as a continuous variable. The diet self-efficacy item relating to ‘work’ (How confident are you that you could stick to low-fat healthy foods when you are eating at work/place of study over the next year?) had an additional response which was ‘not applicable’, and this was converted to ‘missing’, making five response categories for each of the eight items. There were five n/a responses changed to ‘missing’ at baseline and six n/a responses changed to ‘missing’
at follow up for this particular item. Detail of data treatment for missing items is described in section 5.7.5. Scores for each item were summed and the total number was divided by eight to give a mean diet self-efficacy score, which was used in the regression analyses.

In a separate analysis, diet self-efficacy, which assessed confidence to eat enough fruit and vegetables included two items; ‘Eat enough fruit for good health’ and ‘Eat enough vegetables for good health’ with five possible responses ranging from ‘not at all confident’ to ‘extremely confident’. These remained as individual, categorical data as intake of both fruit and vegetables had been assessed individually and therefore the intake data and self-efficacy data would be more directly comparable when self-efficacy data also remained standalone. Responses were collapsed into two categories for each (‘not confident/moderately confident’ and ‘very/extremely confident’) to eliminate response categories containing too few numbers of observations.

Five items comprised the PA self-efficacy score with five responses ranging from ‘not at all confident’ to ‘extremely confident’. These responses were given a numerical score (1-5, where 1 was ‘not at all confident’) and treated as a continuous variable. Scores for each item were summed and the total number was divided by five to give a mean PA self-efficacy score, which was used in the regression analyses.
Figure 5.6 Overview of data collection employed in the mums OnLiNE pilot intervention study

<table>
<thead>
<tr>
<th>Baseline</th>
<th>9 months postpartum</th>
<th>INFANT Extend RCT</th>
<th>18 months postpartum</th>
<th>3 years</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Baseline</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Primary outcomes</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Objectively measured anthropometry (INFANT Extend session or home visit)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>OR</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Self-reported anthropometry for women beginning the mums OnLiNE intervention &gt;1 month post objective measurements being taken as per above</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Secondary outcomes</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dietary intake</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PA and Sedentary time</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Diet and PA self-efficacy</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Survey data collected at INFANT session or returned via mail</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>9 months</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Primary outcomes</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Objectively measured anthropometry at final INFANT Extend session or INFANT Extend home visit OR mums OnLiNE supplementary home visit for women completing the mums OnLiNE intervention &gt; 1 month post objective measurements being taken as per above</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Secondary outcomes</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dietary intake</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PA and Sedentary time</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Diet and PA self-efficacy</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Survey data collected at final INFANT Extend session or via mail OR Distributed at the supplementary home visit and returned via mail for women completing the mums OnLiNE intervention &gt; 1 month post the last INFANT Extend session</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
5.7.3 Data management and statistical analyses

Questionnaires were manually checked for errors by trained research assistants. When data were missing, mothers were contacted by telephone and the relevant data was collected. In cases where data were not able to be obtained, data remained missing and was subsequently excluded from the analyses for a given item. The food frequency data was scanned by the CCV and transferred into an appropriate datasheet for analysis. All other data arising from the questionnaire, as well as anthropometry data and maternal details were entered by research staff into a custom designed Microsoft Access database. Data were then transferred into SPSS statistical package and a range of logistical checks were performed. Data were analysed using SPSS statistical package version 21 or for regression analyses assessing the intervention effect, Stata Version 12 was used to allow controlling for clustering by first time mother’s group. Statistical significance was set as $p < 0.05$ for all analyses.

Descriptive analyses were used to describe the sample at baseline. One way-analysis of variance (ANOVA) was used to assess the differences in characteristics at baseline. For analysis of the intervention effect, when outcomes were continuous, linear regression was conducted. All continuous outcome measures were checked for normality and detection of outliers using three standard tests (normality histograms, normality Q-Q scatter plots and homoskedasticity scatter plots). Data for PPWR at baseline was detected as an outlier for one participant ($-19.0\text{kg}$) and was truncated to the next minimum value ($-11.4\text{kg}$) for all analyses assessing change in anthropometry from baseline to follow up. Whilst random outliers may be due to inherent variability, or measurement error (559), this value ($-19.0\text{kg}$) resulted from objectively measured weight and was re checked against survey data and deemed to be a valid response. However, removal of an outlier is justifiable when the value falls three or more standard deviation outside the mean of the data (560). Modifying an outlier to be treated like any other data point (in this case, the next minimum value) increases the robustness of the statistical method applied (559) and alleviates any possible bias by retaining an attenuated version of the datum (559). Further, there is no benefit in eliminating the outlier when it has been deemed to be a legitimate measure and it is counter to the basic principle of random sampling (559). All other continuous outcomes were deemed to be normally distributed. When outcomes were categorical, either binomial or multinomial logistic regression were used and data were treated as outlined below.
5.7.4 Confounding factors

The rationale for adjusting for various confounding factors in the analyses was based on previously established literature. As has been previously well documented, GWG is the strongest predictor of PPWR (37, 250, 487). Therefore, in this study when PPWR was the outcome variable, analysis adjusted for GWG. In addition, maternal age and income level were considered confounding factors, and adjusted for in the analyses, based on studies elsewhere which have assessed PPWR (190, 249, 320, 328). Previously, in two separate studies, both maternal age and income were found to be important predictors of PPWR at both three and 12 months postpartum (534) and at nine months postpartum (561). Breastfeeding was not considered a confounding factor as a recent systematic review of 45 studies concluded that more robust research is needed to assess the impact of breastfeeding on PPWR and that the majority of included studies showed little or no association between breastfeeding and postpartum weight change (562).

When maternal WC was the outcome variable, both maternal age and income were likewise adjusted for in the analyses. In addition, the model also adjusted for baseline PPWR. Despite few intervention studies having previously focused on assessing maternal WC in combination with PPWR (320, 326, 328), the majority of PPWR exists centrally (218-220) rather than peripherally and as such, baseline PPWR was considered a confounding factor. Adjusting for PPWR might therefore be considered a strength of this study in assessing the intervention effect on maternal WC.

For dietary intake, PA and sedentary behavior outcomes, both age and income were considered confounding factors and were adjusted for in the analyses. Both maternal age and household income have been regarded as confounding factors in previous studies that have assessed maternal diet (455, 563, 564) and PA (190, 565) during the postpartum period and in studies assessing women’s dietary intakes (417, 566), PA patterns and sedentary behaviours (506) in the general adult population. For consistency, maternal age and income were also adjusted for when diet and PA self-efficacy outcomes were assessed.
5.7.5 Data inclusion and exclusion

A summary of the data included in the analysis for each outcome is presented in Figure 5.7.

Self-reported and objectively measured anthropometry data

At baseline, in the intervention (I) group, 13 women were missing objective data on weight, and 11 were missing objective data on WC. This was due to these women starting the mums OnLiNE program more than one month following their InFANT Extend session, where the anthropometry data was objectively measured. These women instead provided self-reported weight and WC measures, at a point as close as possible to their enrolment in the mums OnLiNE intervention. The potential impact on results of self-reported (as opposed to objective) anthropometric measures was tested for in sensitivity analyses. At follow up, two women in the (I) group self-reported weight and the same two women self-reported WC measures. This was due to one woman having moved interstate and the other being unavailable for a home visit due to work commitments. All recorded anthropometry measures for the (C1) and (C2) groups were objectively measured and no women self-reported data for weight or WC at either baseline or follow up in the two control groups.

Missing data

In the (I) group, one woman declined to have anthropometry objectively measured or provide self-report weight and WC measures at baseline or at the completion of the intervention. One other woman declined WC measures at follow up and did not provide self-reported data. At follow up, seven women in the (C1) group had missing weight and WC and one had missing WC only. Ten women in the (C2) group had missing weight and WC and six had missing WC only. Missing anthropometric measures for the (C1) and (C2) groups at follow up was due to these women not attending the last InFANT Extend session or not being available for a home visit to have anthropometry measures objectively measured.

Complete survey data was available for 27 women in the (I) group, 34 women in the (C1) group and 32 women in the (C2) group. Data were classified as missing when no response for a particular item was given, for each of the diet, PA and self-efficacy outcomes and missing values were subsequently excluded from all analysis on a case-by-case basis for each variable.
Figure 5.7 Overview of data inclusion for maternal outcomes in the mums OnLiNE study for the intervention group and two control groups.
5.8 Results

5.8.1 Participants

An overview of the women completing the mums OnLiNE intervention is presented in Figure 5.8. A total of 54 women (24% of women invited) provided written consent to take part in the mums OnLiNE intervention. Of these, two women became pregnant before completing the baseline phone call and were not enrolled. Three women chose not to participate due to lack of time and nine women were non contactable despite numerous attempts to schedule a baseline phone call. In total 40 women were recruited to the (I) group, from 21 different InFANT Extend first time mother’s groups. Of the 40 participants, 11 women were subsequently withdrawn as they became pregnant during the intervention and one woman dropped out due to loss of contact. In total, 28 women from 16 different InFANT Extend first time mother’s groups completed the intervention (70% retention). During the study, 12 women in (C1) and 17 women in (C2) became pregnant and data for these women were excluded from the analyses.

Figure 5.8 Overview of women completing the mums OnLiNE intervention
Baseline characteristics of the mums OnLiNE intervention group (n=40) and the two matched control groups (n=60; n=60) are presented in Table 5.1. Demographic data for marital status, country of birth, income, education, employment and smoking status were taken from the InFANT Extend baseline survey (three months postpartum) as there was no detail available for this data at nine months postpartum. The majority of women in all three groups were married (I: 82.5%; C1: 70.0%; C2: 78.3%), Australian born (I: 77.5%), (C1: 78.3%), (C2: 76.7%) and university educated (I: 72.5%), (C1: 61.7%), (C2: 61.7%). Just over one third of women in all three groups were classified as low income ($1 – 1499 per week household income) (I: 32.5%), (C1: 38.3%), (C2: 36.7%) with a higher percentage of women in the (C2) group (35.0%) being classified as high income ($2000 per week household income), compared to the (C1) group (23.3%) and the (I) group (20.0%). Almost all women in each group were keeping house/raising children full time (I: 95%), (C1: 90%), (C2: 93.3%) and were non-smokers (I: 95.0%), (C1: 93.3%), (C2: 95.0%). There was no significant difference in mean maternal age at baseline between the three groups (I: 33.2±3.54 years), (C1: 32.4±4.23 years), (C2: 32.9±4.38 years), nor was there a significant difference in baseline weight (I: 70.3±14.71 kg), (C1: 69.8±14.49 kg), (C2: 67.9±13.32 kg), GWG (I: 14.7±5.76 kg), (C1: 14.5±7.49 kg), (C2: 13.2±5.08 kg), pre-pregnancy BMI (I: 25.1±4.28 kg/m²), (C1: 24.0±4.50 kg/m²), (C2 24.7±4.70 kg/m²) or WC (I: 84.9±11.92 cm), (C1: 83.7±12.19 cm), (C2: 82.4±11.18 cm). For all three groups, mean BMI at baseline was higher than pre-pregnancy BMI. At the commencement of the mums OnLiNE intervention, women on average had a BMI within the overweight category (26.0±4.64 kg/m²). Although baseline BMI was not significantly different between the three groups, mean PPWR at baseline was significantly lower for the (C2) group (0.5±6.41 kg) compared to the (C1) group (3.7±6.87) (p=0.025) but not compared to the (I) group (2.4±5.30 kg).
### Table 5.1 Maternal characteristics at baseline

<table>
<thead>
<tr>
<th></th>
<th>Mean ± SD</th>
<th>p-value</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(I) (n=40)</td>
<td>(C1) (n=60)</td>
<td>(C2) (n=60)</td>
<td></td>
</tr>
<tr>
<td>Maternal age (years)</td>
<td>33.2±3.54</td>
<td>32.4±4.23</td>
<td>32.9±4.38</td>
<td>0.656</td>
</tr>
<tr>
<td>BMI (kg/m²)</td>
<td>26.0±4.64</td>
<td>25.4±5.24</td>
<td>24.9±4.71</td>
<td>0.568</td>
</tr>
<tr>
<td>Pre-pregnancy BMI (kg/m²)</td>
<td>25.1±4.28</td>
<td>24.0±4.50</td>
<td>24.7±4.70</td>
<td>0.481</td>
</tr>
<tr>
<td>Weight (kg)</td>
<td>70.3±14.71</td>
<td>69.8±14.49</td>
<td>67.9±13.32</td>
<td>0.663</td>
</tr>
<tr>
<td>Gestational weight gain (GWG) (kg)</td>
<td>14.7±5.76</td>
<td>14.5±7.49</td>
<td>13.2±5.08</td>
<td>0.453</td>
</tr>
<tr>
<td>Postpartum weight retention (PPWR) (kg)</td>
<td>2.4±5.30</td>
<td>3.7±6.87^^</td>
<td>0.5±6.41^^</td>
<td><strong>0.025^^</strong></td>
</tr>
<tr>
<td>Waist circumference (cm)</td>
<td>84.9±11.92</td>
<td>83.7±12.19</td>
<td>82.4±11.18</td>
<td>0.598</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Marital status*</th>
<th>n (%)</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Married</td>
<td>33 (82.5)</td>
<td>42 (70.0)</td>
<td>47 (78.3)</td>
</tr>
<tr>
<td>De facto</td>
<td>6 (15.0)</td>
<td>12 (20.0)</td>
<td>12 (20.0)</td>
</tr>
<tr>
<td>Separated/Divorced</td>
<td>1 (2.5)</td>
<td>3 (5.0)</td>
<td>1 (1.7)</td>
</tr>
<tr>
<td>Never married</td>
<td>-</td>
<td>3 (5.0)</td>
<td>-</td>
</tr>
<tr>
<td>Birth country</td>
<td>n (%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Australia</td>
<td>31 (77.5)</td>
<td>47 (78.3)</td>
<td>46 (76.7)</td>
</tr>
<tr>
<td>UK</td>
<td>1 (2.5)</td>
<td>1 (1.7)</td>
<td>2 (3.3)</td>
</tr>
<tr>
<td>Other</td>
<td>8 (20.0)</td>
<td>12 (20.0)</td>
<td>12 (20.0)</td>
</tr>
<tr>
<td>Weekly household income*</td>
<td>n (%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$1-1499</td>
<td>13 (32.5)</td>
<td>23 (38.3)</td>
<td>22 (36.7)</td>
</tr>
<tr>
<td>$1500-1999</td>
<td>12 (30.0)</td>
<td>12 (20.0)</td>
<td>17 (28.3)</td>
</tr>
<tr>
<td>$2000 or more</td>
<td>8 (20.0)</td>
<td>14 (23.3)</td>
<td>21 (35.0)</td>
</tr>
<tr>
<td>Unsure/Undisclosed</td>
<td>7 (18.0)</td>
<td>11 (18.3)</td>
<td>-</td>
</tr>
<tr>
<td>Education^</td>
<td>n (%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>No qualification/up to year 12</td>
<td>4 (10.0)</td>
<td>6 (10.0)</td>
<td>6 (10.0)</td>
</tr>
<tr>
<td>Trade/apprenticeship/certificate/diploma</td>
<td>7 (17.5)</td>
<td>17 (28.3)</td>
<td>17 (28.3)</td>
</tr>
<tr>
<td>University degree/Higher degree</td>
<td>29 (72.5)</td>
<td>37 (61.7)</td>
<td>37 (61.7)</td>
</tr>
<tr>
<td>Employment status*</td>
<td>n (%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Part time work</td>
<td>2 (5.0)</td>
<td>6 (10.0)</td>
<td>3 (5.0)</td>
</tr>
<tr>
<td>Studying full time / unemployed</td>
<td>-</td>
<td>-</td>
<td>1 (1.7)</td>
</tr>
<tr>
<td>Keeping house/raising children full time</td>
<td>38 (95.0)</td>
<td>54 (90.0)</td>
<td>56 (93.3)</td>
</tr>
<tr>
<td>Smoking currently*</td>
<td>n (%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>2 (5.0)</td>
<td>4 (6.7)</td>
<td>3 (5.0)</td>
</tr>
<tr>
<td>No</td>
<td>38 (95.0)</td>
<td>56 (93.3)</td>
<td>57 (95.0)</td>
</tr>
</tbody>
</table>

(I) = intervention group; (C1) = control group 1 (InFANT RCT control group); (C2) = control group 2 (InFANT RCT intervention group)

*Demographics at 3 months postpartum

^BMI and Education (p>0.05) for comparison of means between the intervention group and two control groups

^^significant difference in PPWR (kg) between the C1 and C2 groups
5.8.2 Anthropometry

Change in anthropometry outcomes from baseline to follow up are presented in Table 5.2. Based on data from the full sample (including self-reported anthropometry), there was no significant difference in mean weight change from baseline to follow up in the (I) group (-1.6kg) compared to the (C1) group (-0.9kg) or the (C2) group (-2.7kg). For mean PPWR there was no significant change from baseline to follow up in the (I) group (-1.2kg) compared to the (C1) group (0.0kg) or the (C2) group (-1.2kg). However there was a significant decrease in mean WC measures for the (I) group, from baseline to follow up (-6.4cm) when compared to the change in WC for the (C1) group (-1.1cm) (β-coef(95%CI)=5.59(2.26, 8.93)) (p=0.002) and (C2) group (-3.3cm) (β-coef(95%CI)=6.38(2.69, 10.07)) (p=0.001).

When the analyses excluded all women who had self-reported either weight or WC at baseline or follow up, the results differed. Significant differences in mean weight from baseline to follow up were observed in the (I) group (-3.2kg) compared to the (C1) group (+0.9kg) for weight (β-coef (95%CI)=2.31(0.46, 4.14)) (p=0.016) and PPWR (-0.7kg and 0.0kg respectively) (β-coef(95%CI)=2.16(0.13, 4.18)) but not the (C2) group (-1.2kg) and the significant difference in WC remained, when the (I) group (-5.2cm) was compared to both the (C1) (-1.1cm) (β-coef (95%CI)=5.19(1.04, 9.34)) (p=0.016) and (C2) (-3.3cm) groups (β-coef (95%CI)=6.12(1.31, 10.95) (p=0.014).
Table 5.2 Anthropometric outcomes and comparison of anthropometry between the intervention and control groups†

<table>
<thead>
<tr>
<th></th>
<th>Baseline</th>
<th>Follow up</th>
<th>(C1) (^\dagger)</th>
<th>(C2) (^\dagger)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean ± SD</td>
<td>Mean ± SD</td>
<td>(\beta)-coef (95%CI)</td>
<td>p-value</td>
</tr>
<tr>
<td>Including self-report data</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Weight (kg)*</td>
<td>71.0±14.77</td>
<td>69.7±14.52</td>
<td>70.6±14.82</td>
<td>67.3±11.6</td>
</tr>
<tr>
<td></td>
<td>(n=26)</td>
<td>(n=48)</td>
<td>(n=27)</td>
<td>(n=41)</td>
</tr>
<tr>
<td>PPWR (kg)^</td>
<td>2.9±5.99</td>
<td>3.3±6.72</td>
<td>1.6±5.64</td>
<td>3.3±7.46</td>
</tr>
<tr>
<td></td>
<td>(n=26)</td>
<td>(n=43)</td>
<td>(n=27)</td>
<td>(n=41)</td>
</tr>
<tr>
<td>Waist circumference (cm)~</td>
<td>84.7±12.03</td>
<td>83.9±12.37</td>
<td>78.3±10.02</td>
<td>81.6±11.21</td>
</tr>
<tr>
<td></td>
<td>(n=26)</td>
<td>(n=43)</td>
<td>(n=27)</td>
<td>(n=41)</td>
</tr>
<tr>
<td>Excluding self-report data⁰</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Weight (kg)*</td>
<td>65.7±12.57</td>
<td>69.7±14.52</td>
<td>70.6±14.82</td>
<td>67.3±11.6</td>
</tr>
<tr>
<td></td>
<td>(n=26)</td>
<td>(n=48)</td>
<td>(n=27)</td>
<td>(n=41)</td>
</tr>
<tr>
<td>PPWR (kg)^</td>
<td>1.37±4.76</td>
<td>3.3±6.71</td>
<td>1.6±5.64</td>
<td>3.3±7.46</td>
</tr>
<tr>
<td></td>
<td>(n=26)</td>
<td>(n=43)</td>
<td>(n=27)</td>
<td>(n=41)</td>
</tr>
<tr>
<td>Waist circumference (cm)~</td>
<td>79.9±10.46</td>
<td>83.9±12.37</td>
<td>74.75±7.59</td>
<td>81.6±11.21</td>
</tr>
<tr>
<td></td>
<td>(n=26)</td>
<td>(n=43)</td>
<td>(n=27)</td>
<td>(n=41)</td>
</tr>
</tbody>
</table>

(\(^\dagger\)) = intervention group; (C1) = control group 1 (InFANT RCT control group); (C2) = control group 2 (InFANT RCT intervention group)

\(^\dagger\)Linear regression; \(^\dagger\dagger\)Results compared to the mums online intervention (I) group for (C1) and (C2)

*Intervention effects for weight (kg) when adjusted for age, income and PPWR and clustering by first time mother’s group

^Intervention effects for PPWR (kg) when adjusted for age, income and GWG and clustering by first time mother’s group

~Intervention effects for waist circumference (cm) when adjusted for age, income and PPWR and clustering by first time mother’s group

⁰Anthropometric data excluded if self-reported at either baseline or follow up for weight or WC (I) group (n=12) included; (C1) group (n=41) included; (C2) group (n=33) included and adjusted accordingly as for the analysis including self-report data
5.8.3 Dietary intake

Change in fruit and vegetable intake from baseline to follow up are presented in Table 5.3. Just over half of women were meeting fruit recommendations of two or more serves per day at baseline across all three groups (I: 57.1%; C1: 60.4%; C2: 53.5%). There was no significant difference in change in fruit intake (serves/day) or change in the proportion of women who were meeting recommendations for fruit intake from baseline to follow up in the (I) group compared to the (C1) or the (C2) group. A much lower proportion of women across all three groups were meeting vegetable recommendations of five or more serves per day (I: 7.1%; C1:4.2%; C2:11.6%). The change in vegetable intake (serves/day) from baseline to follow up for the (I) group (7.1%; 14.8%) was borderline significant when compared to the (C1) group (4.2%; 10.6%) (RR (95%CI)=3.72(0.99-13.95)) (p=0.051). There was no significant difference in the proportion of women who were meeting recommendations for vegetable intake from baseline to follow up in the (I) group compared to the (C1) or the (C2) group or combined fruit and vegetable intake from baseline to follow up in the (I) group (3.6%; 11.1%) compared to the (C1) group (2.1%; 2.1%) or the (C2) group (4.7%; 6.3%). Nonetheless, an upward trend was evident among women in the (I) group.

Frequency of intake of each of the non-core food groups (crisps, chocolate/lollies, cakes/biscuits, pies/sausage rolls) and change in frequency of intake from baseline to follow up are presented in Table 5.4. The proportion of women consuming crisps ‘never/1-3 times per week’ remained relatively unchanged from baseline to follow up in the (I) group (75.0%; 81.5%). This was significantly different to the (C2) group whereby the proportion of women consuming crisps ‘never/1-3 times per week’ decreased from baseline to follow up (60.5%; 53.2%) (RR (95%CI)=3.48(1.15-10.52)) (p=0.027). There was no significant difference in the proportion of women consuming any of the other non-core foods from baseline to follow up in the (I) group compared to the (C1) group or the (C2) group.
| Table 5.3 Fruit and vegetable intake and comparison between the intervention and control groups from baseline to follow up† |
|----------------------------------|-----------|-----------|-----------|-----------|-----------|
|                                  | Baseline | Follow up | C1*       | OR/RRR (95%CI) | p-value | C2*       | OR/RRR (95%CI) | p-value |
| Fruit intake (serves/day)        |          |           |           |             |         |           |             |         |
| None/less than 1 serve           | (n=27)   | (n=32)    | (I)       | (C1)       | (C2)    | (I)       | (C1)       | (C2)    |
| 1 serve/day                      | 1 (3.6)  | 8 (16.7)  | 5 (11.6)  | 2 (7.4)    | 5 (10.4) | 3 (9.4)   |             |         |
| 2 or more serves                 | 11 (39.3)| 11 (22.9) | 15 (34.9) | 10 (37.0)  | 10 (26.3)| 12 (37.5) |             |         |
| Vegetable intake (serves/day)    |          |           |           |             |         |           |             |         |
| None/less than 1 serve           | (n=27)   | (n=32)    | (I)       | (C1)       | (C2)    | (I)       | (C1)       | (C2)    |
| 1-2 serves                       | 0        | 4 (14.8)  | 4 (14.8)  | 17 (44.7)  | 12 (37.5) |             |         |
| 3-4 serves                       | 17 (60.7)| 21 (43.8) | 19 (44.2) | 19 (70.3)  | 17 (44.7)| 17 (53.1) |             |         |
| 5 or more serves                 | 2 (7.1)  | 4 (4.2)   | 5 (11.6)  | 4 (14.8)   | 3 (9.4)  |             |         |
| Fruit intake meets recommendations|          |           |           |             |         |           |             |         |
| Yes                              | 16 (57.1)| 29 (60.4)| 23 (53.5)| 15 (55.6)| 29 (60.4)| 17 (53.1) |             |         |
| No                               | 12 (42.9)| 19 (39.6)| 20 (46.5)| 12 (42.9)| 19 (39.6)| 15 (46.9) |             |         |
| Vegetable intake meets recommendations|        |           |           |             |         |           |             |         |
| Yes                              | 2 (7.1)  | 2 (4.2)   | 5 (11.6)  | 4 (14.8)   | 2 (4.2)  | 3 (9.4)    |             |         |
| No                               | 26 (92.9)| 46 (95.8)| 38 (88.4)| 23 (85.2)| 46 (95.8)| 29 (90.6) |             |         |
| Fruit & vegetable intake         |          |           |           |             |         |           |             |         |
| intake meets recommendations      | (n=27)   | (n=32)    | (I)       | (C1)       | (C2)    | (I)       | (C1)       | (C2)    |
| Yes                              | 1 (3.6)  | 1 (2.1)   | 2 (4.7)   | 3 (11.1)   | 1 (2.1)  | 2 (6.3)   |             |         |
| No                               | 27 (96.4)| 47 (97.9)| 41 (95.3)| 24 (88.9)| 47 (97.9)| 30 (93.8) |             |         |

(I) = intervention group; (C1) = control group 1 (InFANT RCT control group); (C2) = control group 2 (InFANT RCT intervention group)

†Logistic regression; †Results compared to the mums online intervention (I) group for (C1) and (C2)

*Intervention effects for fruit and vegetable outcomes adjusted for age and income and clustering by first time mother’s group

(I) group (n=28); (C1) group (n=48); (C2) group (n=43) unless otherwise stated

156
Table 5.4 Non-core food intake and comparison between the intervention and control groups from baseline to follow up†

<table>
<thead>
<tr>
<th></th>
<th>Baseline</th>
<th>Follow up</th>
<th>RRR (95%CI)</th>
<th>p-value</th>
<th>RRR (95%CI)</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(I) n (%)</td>
<td>(C1) n (%)</td>
<td>(C2) n (%)</td>
<td>(I) n (%)</td>
<td>(C1) n (%)</td>
<td>(C2) n (%)</td>
</tr>
<tr>
<td>Crisps</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Never/1-3 times per month</td>
<td>21 (75.0)</td>
<td>28 (58.4)</td>
<td>26 (60.5)</td>
<td>22 (81.5)</td>
<td>28 (73.7)</td>
<td>17 (53.2)</td>
</tr>
<tr>
<td>1-4 times per week</td>
<td>7 (25.0)</td>
<td>20 (41.6)</td>
<td>14 (32.6)</td>
<td>5 (18.5)</td>
<td>9 (23.7)</td>
<td>14 (43.8)</td>
</tr>
<tr>
<td>5-6 times per week</td>
<td>-</td>
<td>1 (2.3)</td>
<td>-</td>
<td>1 (2.6)</td>
<td>-</td>
<td>1 (3.1)</td>
</tr>
<tr>
<td>Once per day or more</td>
<td>-</td>
<td>2 (4.7)</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Chocolate/lollies</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Never/1-3 times per month</td>
<td>10 (35.8)</td>
<td>8 (16.7)</td>
<td>12 (27.9)</td>
<td>6 (22.2)</td>
<td>8 (21.1)</td>
<td>9 (28.2)</td>
</tr>
<tr>
<td>1-4 times per week</td>
<td>6 (21.4)</td>
<td>27 (56.3)</td>
<td>24 (55.8)</td>
<td>12 (44.4)</td>
<td>23 (60.5)</td>
<td>18 (56.2)</td>
</tr>
<tr>
<td>5-6 times per week</td>
<td>7 (25.0)</td>
<td>5 (10.4)</td>
<td>5 (11.6)</td>
<td>3 (11.1)</td>
<td>2 (5.3)</td>
<td>1 (3.1)</td>
</tr>
<tr>
<td>Once per day or more</td>
<td>5 (17.8)</td>
<td>8 (16.7)</td>
<td>2 (4.7)</td>
<td>6 (22.2)</td>
<td>5 (10.5)</td>
<td>4 (12.5)</td>
</tr>
<tr>
<td>Cakes/biscuits</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Never/1-3 times per month</td>
<td>9 (32.1)</td>
<td>17 (35.4)</td>
<td>21 (48.9)</td>
<td>9 (32.2)</td>
<td>13 (27.1)</td>
<td>8 (18.6)</td>
</tr>
<tr>
<td>1-4 times per week</td>
<td>12 (42.9)</td>
<td>28 (58.4)</td>
<td>19 (44.2)</td>
<td>16 (57.2)</td>
<td>22 (65.8)</td>
<td>23 (53.5)</td>
</tr>
<tr>
<td>5-6 times per week</td>
<td>4 (14.3)</td>
<td>1 (2.1)</td>
<td>1 (2.3)</td>
<td>2 (7.1)</td>
<td>-</td>
<td>1 (2.3)</td>
</tr>
<tr>
<td>Once per day or more</td>
<td>5 (10.7)</td>
<td>2 (4.2)</td>
<td>2 (4.7)</td>
<td>-</td>
<td>3 (6.3)</td>
<td>-</td>
</tr>
<tr>
<td>Pies/sausage rolls</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Never/1-3 times per month</td>
<td>23 (82.1)</td>
<td>43 (89.6)</td>
<td>38 (88.3)</td>
<td>25 (92.6)</td>
<td>32 (84.2)</td>
<td>31 (96.9)</td>
</tr>
<tr>
<td>1-4 times per week</td>
<td>5 (17.8)</td>
<td>5 (10.4)</td>
<td>4 (9.3)</td>
<td>2 (7.4)</td>
<td>6 (15.8)</td>
<td>1 (3.1)</td>
</tr>
<tr>
<td>5-6 times per week</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Once per day or more</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

†Logistic regression; *Results compared to the mums online intervention (I) group for (C1) and (C2)*

*I* = intervention group; *(C1)* = control group 1 (InFANT RCT control group); *(C2)* = control group 2 (InFANT RCT intervention group)

*Intervention effects for non-core food outcomes adjusted for age and income and clustering by first time mother’s group (I) group (n=28); (C1) group (n=48); (C2) group (n=43) unless otherwise stated*
5.8.4 Physical activity

Change in PA from baseline to follow up is presented in Table 5.5. There was no significant difference in mean time (minutes) spent walking, from baseline to follow up in the (I) group (206.61±161.14; 207.68±149.58) compared to the (C1) group (259.96±193.89; 264.46±221.03) or the (C2) group (211.63±193.80; 180.78±154.54), moderate activity ((I): 29.29±47.29, 55.36±89.79; (C1): 40.64±85.83, 54.05±115.72; (C2): 27.21±62.08, 28.06±53.63), vigorous activity ((I): 113.57±163.09, 100.18±111.94; (C1): 107.40±171.74, 82.37±103.64; (C2): 49.19±76.16, 75.31±79.36) or total PA time ((I): 349.46±273.92, 363.21±248.83; (C1): 405.08±345.23, 387.29±307.48; (C2): 288.02±275.07, 289.52±230.90). For all three groups, at both baseline and follow up, mean time spent walking was greater than time spent in either moderate or vigorous activity (Table 5.5). There was no significant difference in the proportion of women meeting PA recommendations from baseline to follow up in the (I) group (75.0%; 78.6%) compared to the (C1) group (69.6%; 64.9%) or the (C2) group (53.5%; 67.7%). The majority of women in all three groups reported meeting PA recommendations at both baseline and follow up.

5.8.5 Sedentary behaviour

Change in TVD/DVD/video time (as a proxy for sedentary behaviour) from baseline to follow up is presented in Table 5.5. For TV/DVD/video time there was no significant difference in mean total time (minutes) from baseline to follow up in the (I) group (177.17±158.27; 111.56±60.01) compared to the (C1) group (154.96±172.09; 113.67±75.53) or to the (C2) group (195.66±154.25; 135.91±83.96). Likewise there was no significant difference in mean TV/DVD/video time in the (I) group compared with the (C1) group or the (C2) group from baseline to follow up on weekdays days ((I): 185.89±186.30, 111.61±63.32; (C1): 159.06±194.61, 99.34±73.71; (C2): 209.19±198.97, 132.27±103.89) or on weekend days (I): 155.36±92.40, 149.47±171.59; (C1): 144.69±147.86, 149.47±171.59; (C2): 161.86±81.28; 145.00±64.81).
Table 5.5 Physical activity and sedentary behaviour patterns and comparison between the intervention and control groups from baseline to follow up*

<table>
<thead>
<tr>
<th></th>
<th>Baseline</th>
<th>Follow up</th>
<th>C1†</th>
<th>C2†</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean ± SD</td>
<td>Mean ± SD</td>
<td>β-coef (95%CI)</td>
<td>p-value</td>
</tr>
<tr>
<td><strong>Total PA (min/week)</strong></td>
<td>349.46±273.92</td>
<td>405.08±345.23</td>
<td>-30.17 (-147.18, 86.84)</td>
<td>0.606</td>
</tr>
<tr>
<td></td>
<td>387.29±307.48</td>
<td>289.52±230.90</td>
<td>31.91 (-59.99, 118.80)</td>
<td>0.463</td>
</tr>
<tr>
<td><strong>Walking (min/week)</strong></td>
<td>206.61±161.14</td>
<td>259.96±193.89</td>
<td>-20.13 (-73.64, 33.38)</td>
<td>0.452</td>
</tr>
<tr>
<td></td>
<td>211.63±193.80</td>
<td>207.68±149.58</td>
<td>54.05±115.72</td>
<td>28.06±53.63</td>
</tr>
<tr>
<td><strong>Moderate (min/week)</strong></td>
<td>29.29±47.29</td>
<td>40.64±85.83</td>
<td>-21.56 (-54.99, 118.80)</td>
<td>0.463</td>
</tr>
<tr>
<td></td>
<td>27.21±62.08</td>
<td>55.36±89.79</td>
<td>-20.13 (-73.64, 33.38)</td>
<td>0.452</td>
</tr>
<tr>
<td><strong>Vigorous (min/week)</strong></td>
<td>113.57±163.09</td>
<td>107.40±171.74</td>
<td>23.68 (-31.53, 39.21)</td>
<td>0.828</td>
</tr>
<tr>
<td></td>
<td>100.18±111.94</td>
<td>82.37±103.64</td>
<td>11.62 (-33.73, 57.85)</td>
<td>0.508</td>
</tr>
<tr>
<td><strong>Total TV/DVD/video time (min/day)</strong></td>
<td>177.17±158.27</td>
<td>154.96±172.09</td>
<td>3.84 (-31.53, 39.21)</td>
<td>0.828</td>
</tr>
<tr>
<td></td>
<td>195.66±154.25</td>
<td>111.56±60.01</td>
<td>11.62 (-33.73, 57.85)</td>
<td>0.508</td>
</tr>
<tr>
<td><strong>TV/DVD/video time weekday (min/day)</strong></td>
<td>159.06±194.61</td>
<td>111.61±63.32</td>
<td>3.84 (-31.53, 39.21)</td>
<td>0.828</td>
</tr>
<tr>
<td></td>
<td>209.19±198.97</td>
<td>99.34±73.71</td>
<td>11.62 (-33.73, 57.85)</td>
<td>0.508</td>
</tr>
<tr>
<td><strong>TV/DVD/video time weekend day (min/day)</strong></td>
<td>113.67±75.53</td>
<td>135.91±83.96</td>
<td>11.62 (-33.73, 57.85)</td>
<td>0.508</td>
</tr>
<tr>
<td><strong>PA meets recommendations</strong></td>
<td>11.67±75.53</td>
<td>132.27±103.89</td>
<td>11.62 (-33.73, 57.85)</td>
<td>0.508</td>
</tr>
<tr>
<td></td>
<td>111.43±62.64</td>
<td>149.47±171.59</td>
<td>11.62 (-33.73, 57.85)</td>
<td>0.508</td>
</tr>
<tr>
<td></td>
<td>144.69±147.86</td>
<td>145.00±64.81</td>
<td>11.62 (-33.73, 57.85)</td>
<td>0.508</td>
</tr>
</tbody>
</table>

(I) = intervention group; (C1) = control group 1 (InFANT RCT control group); (C2) = control group 2 (InFANT RCT intervention group)

†Linear and logistic regression; † Results compared to the mums online intervention (I) group for (C1) and (C2)

*Intervention effects for PA and sedentary behaviour outcomes adjusted for age and income and clustering by first time mother’s group (I) group (n=28); (C1) group (n=48); (C2) group (n=43) unless otherwise stated

PA (physical activity)

159
5.8.6 Diet and physical activity self-efficacy

Change in diet and PA self-efficacy are presented in Table 5.6. There was no significant difference in change in mean diet self-efficacy scores from baseline to follow up in the (I) group (3.17±0.94, 2.98) compared with the (C1) group (3.11±0.83, 2.95±0.87) or the (C2) group (3.09±0.81, 3.02±0.77). Further, there was no significant difference between the (I) group compared with the (C1) group or the (C2) group in the proportion of women who were very/extremely confident they could eat enough fruit for good health from baseline to follow up ((I): 75.0%, 65.3%; (C1): 64.5%, 80.1%; (C2): 59.5%, 67.7%) or enough vegetables for good health from baseline to follow up ((I): 77.9%, 78.5%; (C1): 77.0%, 86.5%; (C2): 76.2%, 77.4%). There was no significant difference in mean PA self-efficacy score from baseline to follow up in the (I) group (2.99±0.91, 2.67±0.80) compared with the (C1) group (2.68±0.82, 2.67±0.80) or the (C2) group (2.75±0.92, 2.72±0.71).
Table 5.6 Diet and physical activity self-efficacy and comparison between the intervention and control groups from baseline to follow up†

<table>
<thead>
<tr>
<th></th>
<th>Baseline (I)</th>
<th>Baseline (C1)</th>
<th>Baseline (C2)</th>
<th>Follow up (I)</th>
<th>Follow up (C1)</th>
<th>Follow up (C2)</th>
<th>C1*</th>
<th>C2*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diet self-efficacy score</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean ± SD</td>
<td>3.17±0.94</td>
<td>3.11±0.83</td>
<td>3.09±0.81</td>
<td>2.98±1.00</td>
<td>2.95±0.87</td>
<td>3.02±0.77</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(\beta) coef (95%CI)</td>
<td>-0.03 (-0.36, 0.41)</td>
<td>0.012 (-0.33, 0.57)</td>
<td>0.592</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>p-value</td>
<td>0.886</td>
<td>0.511</td>
<td>0.603</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Eating enough fruit for health</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Not confident to moderately confident</td>
<td>7 (25.0)</td>
<td>17 (35.5)</td>
<td>17 (40.5)</td>
<td>10 (35.8)</td>
<td>7 (18.9)</td>
<td>10 (32.2)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Very/extremely confident</td>
<td>21 (75.0)</td>
<td>37 (64.5)</td>
<td>25 (59.5)</td>
<td>18 (65.3)</td>
<td>30 (80.1)</td>
<td>21 (67.7)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>OR (95%CI)</td>
<td>3.95 (0.79, 19.85)</td>
<td>1.55 (0.42, 5.73)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Eaten, compared to the mums online intervention (I) group (n=28); (C1) group (n=48); (C2) group (n=43) unless otherwise stated</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Eating enough vegetables for health</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Not confident/moderately confident</td>
<td>9 (22.1)</td>
<td>11 (23.0)</td>
<td>10 (23.8)</td>
<td>6 (21.5)</td>
<td>5 (13.5)</td>
<td>7 (22.6)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Very/extremely confident</td>
<td>21 (77.9)</td>
<td>37 (77.0)</td>
<td>32 (76.2)</td>
<td>22 (78.5)</td>
<td>32 (86.5)</td>
<td>24 (77.4)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>OR (95%CI)</td>
<td>1.55 (0.42, 5.73)</td>
<td>0.511 (0.26, 3.20)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Physical activity self-efficacy score</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean ± SD</td>
<td>2.99±0.91</td>
<td>2.68±0.82</td>
<td>2.75±0.92</td>
<td>2.76±0.81</td>
<td>2.67±0.80</td>
<td>2.72±0.71</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(\beta) coef (95%CI)</td>
<td>-0.03 (-0.24, 0.30)</td>
<td>0.814 (-0.26, 0.25)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>p-value</td>
<td>0.949</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

(I) = intervention group; (C1) = control group 1 (InFANT RCT control group); (C2) = control group 2 (InFANT RCT intervention group)
†Logistic regression; †Results compared to the mums online intervention (I) group for (C1) and (C2)
\(i\) group (n=28); (C1) group (n=48); (C2) group (n=43) unless otherwise stated

*Intervention effects for diet and physical activity self-efficacy outcomes adjusted for age and income and clustering by first time mother’s group
5.9 Discussion

This chapter has reported the methodology and results of the mums OnLiNE pilot intervention study with first time mothers. Overall, the intervention was successful in reducing PPWR and WC measures yet there was no significant improvement in healthy lifestyle behaviours or diet and PA self-efficacy.

Interestingly, the results for PPWR showed a more favourable effect when examining objective anthropometric data only. When self-reported weight, either at baseline or at follow up was excluded from the analysis, the intervention was effective in limiting PPWR when compared to the (C1) group. With studies having previously shown that under-reporting of weight and BMI tends to be common amongst overweight adults (464, 469, 470) expected inaccuracies in self-reported data in this study would have been towards more favourable outcomes (under-reporting of body weight). However, possible reasons related to body dissatisfaction could be one factor which influenced self-reported weight being less ‘socially desirable’ for women in this study. Body dissatisfaction during the postpartum period has been previously documented (380, 472, 567), whereby women have been found to assume negative feelings towards increases in their weight at the waist and hips particularly (471), changes which commonly occur as a result of pregnancy weight gain. Furthermore, in a US study conducted by Gjerdingen et al. (2009) (n=506) body dissatisfaction was found to worsen from one month to nine months postpartum (387). In any case, further research into the perceptions women have of their own postpartum weight is warranted, and could provide important information about readiness for weight-loss and voluntary uptake of participation in supportive programs which target healthy weight attainment.

The results showed a significant reduction in WC measures in mothers taking up the mums OnLiNE program compared with women in both control groups. As abdominal obesity, assessed by WC, has been regarded as a better independent predictor of obesity related disorders than assessment of BMI alone, or general obesity (76, 77), assessment of WC was a methodological strength of this study. The significant reduction in WC measurements in the (I) group was a key finding in terms of public health relevance. As was discussed previously in Chapter 2 (2.6.4) PPWR appears to be distributed centrally for most women (218, 537), placing this population sub-group at increased risk for multiple cardio-metabolic diseases (319). The presence of abdominal obesity indicates the need for health promoting interventions in
populations such as first time mothers who would otherwise not be considered at risk for obesity related morbidity based on general obesity alone (76, 568).

Of concern in this study, mean WC measures across all three groups at baseline were above the WHO recommendation of $\leq 80$cm, a cut-off point for reduced risk of metabolic complication (458). Waist circumference measures above recommended levels have been frequently associated with insulin resistance (569, 570), T2DM (476, 569) dyslipidaemia (476, 569) and CHD (477, 569), yet even modest reductions in WC have been shown to reduce risk factors for poor cardio-metabolic health such as hyperglycemia, high blood pressure and triglyceride levels (478). Therefore, future interventions following childbirth should focus weight reduction strategies on reducing WC, in combination with efforts to reduce PPWR rather than just on PPWR alone.

The proportion of women consuming five or more serves of vegetables per day increased to levels approaching statistical significance in the mums OnLiNE intervention group, compared to the C1 group. Yet overall the intervention was not successful in significantly improving dietary intakes. These results are similar to those of multiple PPWR focussed interventions (270, 320, 326-328, 330). Interventions which have successfully reduced PPWR and improved maternal diet (324, 325, 329) have utilised one-on-one, face-to-face dietary counselling, including home visits delivered by a dietitian, (324, 325) or trained nurse (329). Elsewhere, a systematic review of interventions to promote fruit and vegetable intake showed consistent positive effects of interventions which utilised face-to-face counselling (391). However, face-to-face counselling may not be a practical approach when considering cost-effectiveness and labour intensity. As discussed in Chapter 2 (2.10.2), telephone delivered interventions offer a cost-effective and flexible means of providing repeated contact, necessary to attain and maintain behavior change (571, 572). Emerging literature also suggests that telephone delivered interventions targeting healthy lifestyle behaviours are feasible with capacity to be successful in ‘real world’ contexts (573, 574).

When assessing intervention studies recruiting postpartum women, telephone support has been successful in promoting breastfeeding (575, 576), reducing symptoms of postnatal depression (577) and postnatal fatigue (578) and in promoting postpartum weight-loss (322). However, uncertainties remain as to the best approaches which might positively impact maternal dietary behaviours via telephone counselling. Future research might aim to determine the ideal
frequency of telephone counselling calls, being effective for promoting healthy behaviours whilst still being feasible to deliver and conducive to the busy lives of new mothers. Perhaps a more rigorous telephone counselling regime including increased frequency of calls to participants in this study might have assisted with further improving vegetable intakes and promoting improved dietary intakes overall.

Regarding PA, the intervention was not successful in increasing weekly total PA time, moderate or vigorous PA or time spent walking. Elsewhere, interventions which have been successful in increasing PA, irrespective of success in limiting PPWR, have utilised varied strategies to promote PA during the postpartum period (270, 323, 327, 329, 410). Interestingly, in this study walking was by far the most prevalent type of PA for women in all three groups both at baseline and follow up. As walking has been found previously to be the most common form of exercise for new mothers (326), these results were not surprising. Moreover, results presented in Chapter 4 (4.4.2) showed that in the larger sample of women enrolled in the InFANT Extend RCT (n=448) (from where the sub-sample of women were drawn from this study), walking was also the most common form of PA at three months postpartum.

Considering many women appear to be already engaged in walking as their preferred form of PA during the postpartum period, building on existing strategies which aim to support women to engage in regular walking for health benefits presents as highly opportunistic. As discussed previously in Chapter 4 (4.5), walking is a highly suitable, functional and low cost activity for new mothers in which to engage, and even at a low or moderately intensity, regular walking for even short periods (approximately 25 minutes) has been found to reduce risk factors for chronic disease as well as postpartum BMI (326).

Whilst women in the mums OnLiNE intervention were encouraged to use their pedometer and log daily steps on the website and/or smartphone application, perhaps a more rigorous approach with more specific direction for increasing daily steps would have been beneficial. Daily steps was not an outcome assessed in this intervention yet daily step targets have been shown to be an effective tool in promoting PA and limiting PPWR (410). For example, in their postpartum RCT (n=66), Maturi et al. (2011) found the intervention they prescribed significantly increased mean daily step counts from 3249 to 9960 steps/day. Women in the intervention group were between six weeks and six months postpartum and upon completion of the 12 week intervention period had significantly increased their energy expenditure (to 4394kcal/week)
compared to the control group (1651kcal/week) (410). In addition, the intervention was successful in reducing maternal weight, BMI and waist and hip circumferences.

Similarly the intervention was not effective in increasing the proportion of women who reportedly met AAS guidelines for sufficient PA. However, interestingly, the proportion of women in the (I) group who were meeting PA recommendations at baseline (n=21; 75.0%) was somewhat higher than for the (C2) group (n=43; 53.5%). In addition, total PA time (min/week) was also higher at baseline for women in the (I) group (349.46±273.92), compared to the (C2) group (288.02±275.07). This might suggest that women who took up the mums OnLiNE intervention were already more motivated than other women, to optimise healthy lifestyle habits or reduce their weight. However, it should be acknowledged that the AAS recommendations for PA differ somewhat to the current (2014) Physical Activity Guidelines for Australian Adults (18-64 years) (422) and therefore the actual proportion of mothers meeting the current Australian recommendations for PA is likely to be fewer than the reported proportion meeting recommendations in this study based on the less stringent AAS criteria.

Notwithstanding, women face multiple challenges during the postpartum period, including lack of time and motivation as well as prioritisation of their offspring, all of which can impact on PA participation (274, 323, 434). Yet, studies have consistently reported beneficial associations between postpartum PA and body weight (190, 274, 532, 537, 579). When combined with dietary intervention components, PA is more likely to contribute to limiting PPWR, as reflected by the majority of successful postpartum interventions to date (250, 251, 319), making PA a key contributing factor in the attainment of healthy maternal weight following childbirth.

It should be to acknowledged that watching television/DVDs/videos was used as a proxy for sedentary behaviour in this study. This was the same measure described in Chapter 4 (4.3.3). It is plausible that total sedentary behaviour time for most women would exceed reported time watching television/DVDs/videos, making sedentary time potentially underestimated in this study. Yet this study showed there was a non-significant reduction in TV/DVD/video time during the nine month study period, for all three groups, and that weekday TV/DVD/video time reduced to a greater extent than weekend TV/DVD/video time overall. One possible explanation for this pattern may in part be attributed to the development and progression of children’s gross motor skills and PA with an accompanying reduction in maternal TV/DVD/video time as a result. For example, the movement from tummy to hands and knees...
crawling (traditionally occurring at around 8.5 months) (462) progression to walking (at around 12 months) (462) and a shift to more advanced active play towards two years of age, when children have been regarded as being more physically active than any other life stage (463), corresponds to the timing of the intervention period in this study from approximately nine months postpartum up until 18 months. This period of development could require more active interactions with a caregiver. Therefore mothers may more become more physically active by providing more active support and subsequently reduce their own sitting time, without consciously increasing their leisure time PA. Future work aimed at supporting women to limit PPWR might focus on better understanding these mother-infant interactions in the context of designing interventions to promote reduced maternal sitting time during the postpartum period.

Of the limited amount of literature available assessing postpartum sedentary behaviour, results have been mixed. Assessment of television viewing by Oken et al. (2007) (190) found that in their sample of women, for each hour of daily television viewing the adjusted odds ratio for retaining substantial weight (> 5kg) was 1.24 (95%CI 1.06-1.46). Importantly, the risk for morbidity and mortality are higher for those engaging in greater amounts of sedentary behaviour, with the risks being independent of regular moderate to vigorous PA (550, 558, 580). Therefore a better understanding of new mothers’ sedentary behaviour patterns and assessment of barriers to reducing sedentary time during the months following childbirth are important considerations in management of weight retention during this time.

It is plausible that limitations with the measurement tools used to assess dietary intake and PA in this study could in part explain why significant improvements in these outcomes were not observed despite WC and PPWR significantly improving as a result of the intervention. For example, assessment of dietary intake relied on use of an abbreviated FFQ at baseline and the more extensive CCVDQES at follow up. The limitations of this methodology are discussed in greater detail in section 5.10. However, using different dietary measurement tools meant that a number of important food items and the assessment of their consumption were unable to be included in this study. Change in intakes of some food items which might potentially have contributed to weight-loss was unable to be assessed. For example decreased intake of energy dense foods and beverages such as sugar sweetened beverages and snack foods has been associated with reduced body weight in adults (581) yet intake of soft drinks and other sugar sweetened beverages were unable to be assessed in women in this study.
Furthermore, considering assessment of PA using the AAS, the survey asked women to report durations and intensities of PA retrospectively for the previous seven days. Therefore, it is likely that the results are not reflective of changes in PA across the entire nine month intervention period. Improvements in PA duration and/or intensity at different times throughout the intervention may in part have accounted for the observed improvements in PPWR and WC. It is likely that PA levels fluctuated with seasonal barriers or women returning to work, limiting the time available to be physically active, yet these factors were unable to be assessed.

Women in this study may have elected to self-monitor their weight and/or WC rather than focus on diet and PA behaviour tracking for many reasons which are unable to be determined. Self-monitoring of weight in general adult cohorts has been found to be an important, standalone component for weight-loss (438, 443), yet in postpartum women this is an area requiring further investigation. During pregnancy, self-monitoring of weight without diet and PA intervention components has been shown to be an effective method of limiting GWG (315). Encouraging women to regularly self-monitor and record their weight may be a valuable tool to implement as part of future interventions (320, 582).

In terms of self-efficacy, this study showed no significant difference in diet self-efficacy score from baseline to follow up, between the (I) group and two control groups. There was also no significant change in perceived confidence level in eating sufficient fruit or vegetables for health benefit. However the lack of improvement in self-efficacy may in part be explained by the high proportion of women (approximately half to two thirds) who at baseline reported already being very/extremely confident they could eat sufficient fruit and vegetables for health, making further improvement not possible or unable to be detected.

Whilst it was beyond the scope of the study aims to determine whether self-efficacy was associated with dietary intake, the results might suggest that self-efficacy was not related to dietary intake, considering that many women overall were not meeting fruit (42.8%) or vegetable (92.4%) recommendations at baseline, or at follow up (42.9% and 91.5% respectively). However, further investigation is warranted regarding self-efficacy and associated dietary intake in new mothers, considering that self-efficacy has been previously regarded as one of the most consistent factors associated with fruit and vegetable intake in adult populations (377, 403).
Similar to the results for dietary self-efficacy, the intervention was not effective in improving PA self-efficacy. Mean self-efficacy score remained relatively unchanged across the three groups from baseline to follow up. This is an important finding as the strength of a woman’s self-efficacy for leisure time PA has been shown to determine how well she will persist with adopting a physically active lifestyle (274). Specifically during the postpartum period, the importance of bolstering a mother’s PA self-efficacy has been regarded as a key consideration (274) in supporting women to be physically active. A lack of improvement in PA self-efficacy might in part explain why there was no significant improvement in PA observed among the women in this study.

The mums OnLiNE intervention would be applicable in a real-world setting, whereby the low dose and relatively low cost of implementation would infer feasibility in delivering the program to a wider population. However, similar to other postpartum interventions, to date (270, 320, 323-325, 327, 333, 334) there was a low uptake (18%) of women to the mums OnLiNE study. The low uptake of women was despite the intervention being designed to maximise convenience and flexibility via the use of online and telephone delivery. Therefore the overall reach of the program was much lower than expected. Whilst this may have been in part due to the women already participating in the InFANT Extend intervention it also reflects overall the difficulty encountered in recruiting women to such interventions in the period following childbirth, possibly due to competing interests such as family obligations and child care (274). Therefore, development of strategies to engage women successfully during the postpartum period should be a focus for future research.

However the challenge in recruiting women to this study and to other postpartum interventions may not necessarily reflect the motivation or interest women have in attaining a healthy weight or adopting healthy lifestyle behaviours following childbirth. For example, high retention rates (>80%) have been observed in multiple postpartum interventions (324-328, 333, 334) suggesting that limiting PPWR is an area of importance to women (320) once they become engaged in programs to facilitate weight-loss. Retention was also high in this study, (70%). Across all three groups in this study, of the women who were excluded from the follow up analysis, all but one participant was excluded due to becoming pregnant for a second time and had to subsequently be withdrawn from the study. This is a valuable finding in the context of informing future planning of similar interventions. Whilst timing of this intervention needed to coincide with InFANT Extend data collection time points as discussed previously in section
5.5, clearly initiating an intervention nine months following the birth of a woman’s first child may be too late to engage with women regarding PPWR with many becoming pregnant shortly after. Future work addressing ideal timing of intervention delivery should seek to assess the views and perceptions of women themselves, to help gain additional insight into the preferred timing for intervention delivery.

The inter-partum period presents as a vital window of opportunity in which to promote healthy maternal weight (36, 213), as weight retention between the first and second pregnancy has been associated with increased risk for adverse perinatal outcomes even in underweight and healthy weight women (213). Women have been found to be motivated to address their weight during the postpartum period (239, 450) and as such efforts to support new mothers to take up programs to help promote their own healthy lifestyle behaviours are necessary. Moreover, flexible programs are required to meet the specific lifestyle needs of this population (263, 265, 583).

5.10 Strengths & limitations

The mums OnLiNE intervention was able to reduce maternal WC and when excluding self-reported anthropometry data, it was also able to limit PPWR. These results are encouraging, as the mums OnLiNE program has assisted women in achieving possible reductions in risk of weight related morbidity and has helped demonstrate the usefulness of technology-based interventions targeting first time mothers during the postpartum period.

The design and implementation of the mums OnLiNE pilot intervention study builds on the work of the small number of previous interventions aimed at limiting PPWR through promoting healthy diet and PA behaviours, yet its delivery was novel. This was the first intervention of its kind to combine both online or smartphone app capability with telephone based support to promote healthy behaviour change in new mothers. An additional strength of this study was the theoretical underpinning of the intervention. Few interventions targeting PPWR have been underpinned by behaviour change theories (320, 328, 330), which is surprising as successful technology-based weight-loss interventions have frequently utilized SCT in their development (335, 362, 541), recognized as essential in the broader health psychology literature (320, 435).
An additional strength of this study was the assessment of TD/DVD/video time as postpartum sedentary behaviours to date have rarely been investigated. It is important to explore mothers’ TV/DVD/video time as research has consistently identified sedentary behaviour as an independent risk factor for weight gain and chronic diseases including CVD and diabetes (543, 558, 580).

Regarding dietary assessment, a limitation of this study was the slight difference in dietary assessment methods at baseline, compared to at follow up. When asked to report the number of serves of vegetables consumed per day, responses at baseline did not include potatoes as part of vegetable intake. However, at follow up potato was included in quantifying vegetable intake (serves). This may have meant that at baseline, a higher proportion of women were meeting recommendations for vegetable intake (serves/day) than the results showed. Yet, considering such a small proportion of women in the entire sample (7.4%) were meeting recommendations for vegetable intake at follow up, the influence these differences in dietary intake assessment had on vegetable outcomes is likely to be minimal. The abbreviated FFQ was used to collect dietary data at baseline due to 1) the additional costs involved with obtaining further copies of the FFQ and having the FFQ data extrapolated by the CCVs (468) and 2) the desire to minimise the burden on women enrolled in the InFANT Extend RCT whereby extensive survey data was completed on multiple occasions throughout the intervention duration.

It should be acknowledged that the PhD candidate/dietitian who delivered the mums OnLiNE intervention was known professionally to a select proportion of women who elected to take up the mums OnLiNE study, through prior attendance at InFANT Extend sessions and engagement with women through assisting with delivery of the InFANT Extend intervention. There is a possibility that this already established relationship introduced some bias into mothers’ self-reported data, towards more favourable dietary intakes or levels of PA, either at baseline or throughout the intervention. Moreover self-reported dietary intakes (584) and PA data (585) methods utilised in this study are known to be vulnerable to systematic and random measurement error (584) recall bias and biased estimates of behaviour (585).

Due to cost restraints, evaluation of the CalorieKing website and smartphone application usage (e.g. the number of times accessed or login durations) was unable to be determined. Had this been possible, valuable insights would have been gained into associations between frequency
of use of online tools with intervention effects. This would be an important component in informing the design of future, technology-based interventions targeting new mothers. Such assessment was beyond this thesis scope and therefore the most practical form of process evaluation to gain insight into usage of these intervention components was deemed to be via one-on-one interviews with a sample of mothers who completed the mums OnLiNE intervention. That in-depth, qualitative evaluation is presented in the following chapter.

Furthermore, baseline data from the early postpartum period (3 months) was used to describe women’s socio-demographic and employment status. A large proportion of women in this study were defined as not working/looking after children at around 3 months postpartum which may have been vastly different by 9 months. A higher proportion of women than reported at baseline may therefore have returned to work by the beginning of the mums OnLiNE intervention. This may have had some influence on both maternal diet and PA habits yet was unable to be determined. A more thorough assessment would be useful in future studies to ascertain the potential impact of returning to work on maternal diet and PA behaviours.

Finally, despite efforts to recruit a larger sample of women, this study was not powered sufficiently to detect meaningful changes in anthropometry between the intervention and control groups. Small sample sizes have likewise been observed in interventions targeting PPWR to date (270, 320, 323-325, 327, 333, 334). Given pragmatic restraints, this study was designed as a pilot intervention study. Future studies with larger sample sizes, adequately powered to detect meaningful differences in maternal adiposity, are needed to broaden knowledge of effectiveness of postpartum interventions (252).

5.11 Conclusion & implications

The mums OnLiNE pilot intervention has contributed to the emerging body of knowledge regarding opportunities to promote healthy maternal weight and healthy lifestyle behaviours during the postpartum period. Previous studies have shown that interventions which combine both diet and PA components are more likely to be successful in limiting PPWR (250, 251, 319). Findings from the mums OnLiNE pilot intervention study further support this. Whilst the intervention was unable to change the assessed healthy lifestyle behaviours in women following childbirth, the observed change in WC and PPWR bode well for potential
effectiveness of postpartum interventions, implemented by combined online and telephone delivery.

This study has shown that it is possible to engage with women via convenient, cost-effective methods to assist in supporting their healthy weight attainment during the postpartum period and prior to subsequent pregnancies. Importantly, optimal support for women should be initiated early in the inter-partum phase, so that women have sufficient opportunity to attain a healthy BMI and WC prior to subsequent pregnancies.

Future work should seek to understand how supportive strategies for healthy weight and healthy behaviour attainment can overcome the many barriers women face during the postpartum period. Women require additional support to encourage improved dietary habits towards healthier fruit and vegetable intakes and to promote engagement in regular PA, to foster attainment of healthy postpartum weight. Whilst this study has assisted in providing information regarding sedentary behaviour in first time mothers, further studies are needed assessing sedentary behaviour in this population and the impact this might have on PPWR. Furthermore, improving diet and PA self-efficacy is an important consideration in assisting women to achieve healthy lifestyles.

The following chapter (Chapter 6) details the methodology and results of the final study of the thesis, a qualitative study conducted with a sub-sample of women who completed the mums OnLiNE pilot intervention study. Chapter 6 reports findings from a process evaluation of the mums OnLiNE program and summarises participants’ views and perceptions regarding the usefulness of the intervention and suggestions for future interventions targeting PPWR.
Chapter 6

Qualitative evaluation of a postpartum intervention: Views of first time mothers who participated in the mums OnLiNE study

6.1 Introduction

The previous chapter reported quantitative results from the mums OnLiNE pilot intervention study and discussed findings relative to maternal weight, diet and PA outcomes. A qualitative exploration of the usefulness of the intervention components, delivery methods and barriers to participation in the program was necessary, in order to gain an in depth assessment of the intervention appeal, challenges and experiences as reported by first time mothers. This would further help identify future opportunities to assist women in achieving healthy postpartum weight and lifestyle behaviours.

As outlined in Chapter 3, qualitative research provides a flexible approach enabling an analytical assessment of the topic. A descriptive qualitative approach was used in this study to understand more deeply the views of intervention participants; an approach which seeks to uncover ideas or concepts that may not have been anticipated at the outset of the research (401). Qualitative research has an important role in clarifying the values and meanings attributed to people who play different roles within communities and organisations (586) and plays a key role in the development of new methods and materials (586). It has the potential to build capacity for conducting and replicating future research (586).

A recently conducted qualitative study in Singapore assessed early postpartum experiences and support needs of first time mothers (587). It found that women expressed greatest need for support regarding infant care and breastfeeding as well as emotional support. Although that study did not consider maternal weight or healthy diet and PA support, it did outline that promoting positive maternal experiences is an important component of the development of maternity healthcare (587). It also suggested that understanding first time mothers’ encounters plays a key role in provision of support (587). Moreover, as first time mothers are a uniquely important group of women, often faced with feelings of vulnerability (587) and simultaneously confronted with new demands of caring for their infant whilst adapting to potential physical and emotional changes (587, 588), their priorities for support are likely to differ to those of the
general population. As such a detailed understanding of their views and attitudes towards postpartum support is of vital importance in an effort to promote positive physical and mental health overall.

Qualitative research assessing how women perceive postpartum weight and healthy lifestyle support and their views and attitudes towards healthy lifestyle behaviours is scarce. Qualitative studies have previously assessed women’s attitudes towards GWG (259, 279, 589, 590) and assessment of behavioural interventions targeting weight management during pregnancy (304). Of the few studies that have qualitatively assessed maternal weight, diet and/or PA during the postpartum period, participant sub-samples have mainly included low income women (591) and ethnically diverse women (592). These studies have focussed on views regarding the necessity for social support to promote healthy lifestyles following childbirth (591) and attitudes towards postpartum weight and PA (592). In the latter study, the majority of women identified weight as an important issue following childbirth and many of the women had a desire to weigh less than they currently did (592).

More recently, in a study in the US, women reported their experience with trying to lose weight during the postpartum period as one of achieving balance between multiple and varied life roles (400). The authors of that study proposed that individualised weight management strategies must consider women’s feelings, assist in the removal of barriers and encourage healthy choices in diet and PA (400). Qualitative analyses of such themes is a favourable approach to gaining such insight as the use of qualitative methods in evaluating interventions has capacity to consider specific needs and resources of a target population (593) which can further advance knowledge and practice (593).

This chapter describes a unique qualitative study assessing a postpartum intervention with first time mothers. It builds on the results presented in Chapter 5 by documenting the experiences of a sub-sample of women who completed the mums OnLiNE intervention. Further, this study seeks to explore how women feel they might be best supported to attain healthy weight and lifestyle behaviours following childbirth and as such has capacity to inform the design of future postpartum interventions.
6.2 Aims

This study sought to assess the perspectives of first time mothers who completed the mums OnLiNE pilot intervention study regarding how appropriate and useful the intervention and its components were, and to understand how new mothers can be best supported to attain healthy weight and healthy lifestyle behaviours during the postpartum period. The aims of the study were to:

- document the experiences of first time mothers who participated in the mums OnLiNE pilot intervention study;
- gain an understanding of their involvement in the intervention and its relevance;
- assess the usefulness of the various intervention components;
- identify barriers to participation and;
- detail mothers’ recommendations for future, similar programs aimed at to supporting women following childbirth

6.3 Methods

6.3.1 Recruitment and data collection

Women who previously took part in the mums OnLiNE pilot intervention study, and who had completed the intervention (n=28) were invited to participate in the study. Purposive sampling was employed whereby selection of participants is deliberate with the intention of addressing a specific purpose (436). In this case the purpose was an exploration of the mums OnLiNE intervention and the experiences of women who had completed the program. As outlined in Chapter 3 (3.3.1), generalisability is achieved via statistical sampling procedures in quantitative research, however such sampling procedures are mostly unavailable in qualitative research (397). In qualitative research, potential participants should be fairly homogenous, and share key similarities related to the research question (428).

Once participants had completed the mums OnLiNE intervention they were sent written information outlining the qualitative study, an invitation to take part in a one-one-one interview, and a plain language statement and consent form. Consent forms were returned via mail, and, once received women were telephoned to schedule a convenient time to take part in
the interview. The recruitment of women continued until saturation of themes (no new emerging themes) was confirmed (259).

All participants provided written informed consent to participate and have the interview digitally recorded. The interviews were conducted one-on-one, via telephone. Due to the unique factors which accompany motherhood, including lack of time to attend structured activities whilst caring for children (434, 594), interviews via telephone were deemed to be most suitable as they could be organised with convenience as a priority. Whilst the absence of visual cues via telephone interviewing may result in a possible loss of contextual data and compromise rapport and interpretation of responses (500), telephone interviewing has the advantage of potentially allowing participants to feel relaxed and able to share sensitive information (500) and there is no evidence that lower quality data is produced via these methods (500).

To eliminate potential bias in responses and to optimise the openness of a discussion regarding the mums OnLiNE intervention, the PhD candidate (a dietitian) who previously delivered the mums OnLiNE intervention, and who was well known to the intervention participants, elected not to conduct the interviews for this study. Rather, a researcher trained in qualitative interviews and with previous experience in qualitative data collection with pregnant women conducted the one-on-one telephone interviews in this study. The researcher has been regarded as the principle tool of data collection in qualitative research (414) and as such this was an important component of the study. Healthcare professionals who have received training in communication skills have been considered as being of potential advantage compared to other novice qualitative researchers (414) and the interviewer was selected, in part, based on this criterion.

Semi-structured interviews were used for this study. The interview questions employed are outlined in Table 6.1. A semi-structured format has the benefit of involving a set of open-ended questions which allows for spontaneous and detailed responses (403, 404). Furthermore, semi-structured interviews offer flexibility in structure, phrasing and probing (414). Once the interview was completed, participants were reimbursed with a store voucher to the value of twenty dollars as a gesture of appreciation and compensation for the time taken to participate in the study. Ethics approval for this study was obtained from the Deakin University Human Research Ethics Committee.
<table>
<thead>
<tr>
<th>Question</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Overall, how useful was the program in helping you achieve your goals for healthy eating, weight and or exercise?</td>
<td></td>
</tr>
<tr>
<td>2. Which aspect or aspects of the mums OnLiNE program did you like most or find most useful?</td>
<td></td>
</tr>
<tr>
<td>3. Which aspect or aspects of the mums OnLiNE program did you dislike or find least useful?</td>
<td></td>
</tr>
<tr>
<td>4. (a) Thinking about the written information you were sent out to start with which did you use and how? (b) Which helped you? Did you use them ongoing over the time?</td>
<td></td>
</tr>
<tr>
<td>5. Did you share any parts of the program with anyone else (e.g. partner, friend, relative or another mum in your mums group)? If yes, did this help you and how did it help?</td>
<td></td>
</tr>
<tr>
<td>6. Were there things that made it difficult for you to participate in the program? If yes, what made it difficult? How did these things make it difficult to participate in the program?</td>
<td></td>
</tr>
<tr>
<td>7. Can you suggest what might make it easier for first time mums like you to participate in a program like mums OnLiNE?</td>
<td></td>
</tr>
<tr>
<td>8. (a) How often did you weigh yourself throughout the mums OnLiNE program? (b) How important do you consider it is to regularly monitor your own weight to assist with weight loss?</td>
<td></td>
</tr>
<tr>
<td>9. (a) How often did you measure your own waist circumference throughout the mums OnLiNE program? (b) How important do you consider it is to regularly monitor your own waist circumference to assist with weight loss?</td>
<td></td>
</tr>
<tr>
<td>10. Has the program influenced your awareness of your daily food intake and if so how?</td>
<td></td>
</tr>
<tr>
<td>11. Has the program influenced your awareness of your daily exercise and if so how?</td>
<td></td>
</tr>
<tr>
<td>12. (a) How useful did you find the telephone calls with the dietitian during the mums online program? (b) Ideally, how often would you have liked the telephone calls to occur (e.g. more frequently, less frequently or three times was enough)?</td>
<td></td>
</tr>
<tr>
<td>13. What parts of the Calorie King website did you use and did you change the way you used the Calorie King website over the nine months? For example did you use different parts of it at different times?</td>
<td></td>
</tr>
<tr>
<td>14. Towards the end of 2012, Calorie King released an iPhone app called the Calorie King Control My Weight app. Did you use the app? If yes, did you find the app useful and what did you like about it? How did it compare to the website?</td>
<td></td>
</tr>
<tr>
<td>15. During the program, did you attempt to lose weight using any other methods? If yes, what other methods did you use?</td>
<td></td>
</tr>
<tr>
<td>16. (a) Thinking into the future, how do you intend to incorporate healthy eating, exercise and maintaining a healthy weight into your everyday life? (b) Do you anticipate this will be a challenge?</td>
<td></td>
</tr>
<tr>
<td>17. (a) Lastly, so that we can understand what first time mums feel they need in terms of diet and exercise or weight loss support, do you have any recommendations or suggestions as to how future programs should provide support for first time mums like you, following childbirth? (b) Do you have any further comments you would like to make?</td>
<td></td>
</tr>
</tbody>
</table>
6.3.2 Data analysis

Anonymity of participants was maintained through the use of de-identified data. All interviews were transcribed verbatim by an online transcribing company. Thematic analysis was used to assess repeated views and accounts across all data. Thematic analysis has previously been described as an effective tool for providing rich and detailed qualitative data (405), as it deals with the emerging literature in an organised and structured manner (437) and allows clear identification of prominent themes (437). The data were analysed firstly by four randomly selected transcripts being read and analysed independently by two researchers (the PhD candidate and an independent researcher who was a co-supervisor of the PhD candidate) to ensure that coding and identification of emerging themes was consistent. The remaining eight transcriptions were analysed by the independent researcher and all transcriptions were then re-analysed by the PhD candidate to ensure consistency. At both stages of the analysis of transcripts, any discrepancies were resolved via discussion between the PhD candidate and co-supervisor.

Interview responses given by the women were grouped into categories relating to their content, allowing summary tables with descriptions of the key points to be produced (437, 439). Data were then organised into overall themes with the integration of multiple supportive quotes for each theme. For the purpose of data reporting in section 6.4 below, as questions included in the interviews relate to intervention content delivered by the PhD candidate, when verbatim quotes refer to the PhD candidate’s name, this has been replaced with [*the dietitian] and any child names have been replaced with [*my child].

6.4 Results

6.4.1 Participants

A total of 13 women out of 28 women invited, responded to the invitation letter and provided written consent to take part in the study. One woman scheduled an interview but was non-contactable at the time scheduled and despite repeated efforts to make contact, she did not respond and therefore did not participate in the study. A total of 12 women took part in the study. Data reached saturation (the interview responses had effectively addressed all aspects of the emerging themes) by the tenth interview, however two further women had already been
recruited, having made scheduled telephone interview times and subsequently their data were also included in the analyses.

6.4.2 Themes

Participant responses clustered into six broad themes:

(i) Program usefulness;
(ii) Intervention components;
(iii) Walking;
(iv) Self-monitoring;
(v) Barriers and challenges;
(vi) Future recommendations

A summary of the supporting verbatim quotes for these themes are presented in Table 6.2.
Table 6.2 Summary of verbatim quotes related to the six broad themes

<table>
<thead>
<tr>
<th>Themes and verbatim quotes</th>
</tr>
</thead>
<tbody>
<tr>
<td>(i) Program usefulness</td>
</tr>
<tr>
<td>“...I found it all pretty good and supportive and yeah, I didn’t even know that programs like this existed before I had [my child], so it was good to be part of it (P07)”</td>
</tr>
<tr>
<td>“...so with the mums OnLiNE I thought well I’m already doing this and, you know, it’s a good thing, it’s obviously extra help for me so it’s not like something that’s going to take a lot of time out, sort of thing (P09)”</td>
</tr>
<tr>
<td>“So, I feel like as a lifestyle thing it’s helped and I feel like maybe in the future I’ll be able to go back to those tools and help with the calorie counting side of it (P08)”</td>
</tr>
<tr>
<td>“Yeah look to be honest, I’m not big on the internet...I probably didn’t get a lot out of it to be 100 per cent truthful (P03)”</td>
</tr>
<tr>
<td>“...I’m just more aware and I guess if some days we eat a bit of crappy food, I’ll make sure that the next couple of days we eat well and yeah, a bit more balanced and more aware of what I have eaten over the week (P07)”</td>
</tr>
<tr>
<td>“I just feel like I’m more aware now of what I’m eating and like I kind of look at a big bowl I’m having of pasta, for example, and I’m kind of a bit more aware of that (P08)”</td>
</tr>
<tr>
<td>“I think it’s been really helpful and it’s kind of, it’s all been a good way to think about your eating all the time, not just crash dieting type programs (P08)”</td>
</tr>
<tr>
<td>“I found I wasn’t drinking that much water, and that kind of made me more aware of it as well (P08)”</td>
</tr>
<tr>
<td>“It probably made me think of useful things like I haven’t been out for a walk and it often still does, now. I think Oh I didn’t get out for a walk today, you know, ’cause you get busy with your washing and your cleaning and doing stuff... (P09)”</td>
</tr>
<tr>
<td>“I can do little things around the house, even [the dietitian] was saying things like when you’re folding the washing, to stand up instead of sitting down all the time...so just being more aware of not sitting so much... (P08)”</td>
</tr>
<tr>
<td>“...because I felt very alone and that, so that just gave me a contact. So I think deep down it was beneficial, yeah (P04)”</td>
</tr>
</tbody>
</table>
“It still felt like I was, I had to leave Melbourne and I left all my friends behind and the mums group that we’d just started and so I felt like I was leaving a lot, but then I still had this, so yeah, it made me feel part of everything again and that was good for me (P07)”

“...a while after I had my son, I did struggle just putting myself as a priority full stop and you feel like you have to clean the house, you have to do this, you can’t exercise because of all these other things, but I got to a point I just said ‘No’, I actually have to do it to look after myself ‘cause I can’t do all of those things if I’m not healthy (P12)”

(ii) Intervention components

“I think the phone calls with [the dietitian] were probably the best because you are able to check and validate things (P02)”

“...but certainly the phone calls are probably the most, for me, particularly most beneficial because you can just talk about what’s current at the time (P03)”

“I think the most useful was the phone calls. And [the dietitian] is lovely and easy to talk to so that was helpful as well (P08)”

“...I think just that motivation and being able to touch base with someone was the most important (P12)”

“She [the dietitian] was really good to talk to and I think, I’ve got all the tools that I need to achieve what I want, I just needed the motivation (P09)”

“...and having her [the dietitian] ring, though, you know I’d start to get a little less motivated and then she’d ring and then, you know, my motivation would get back up...it just boosted my motivation a little bit just talking about it. (P07)”

“...because sometimes I forgot about the program, because, you know, I got busy, but when she [the dietitian] calls, I remind myself that ‘Oh I have to get back on track again (P01)”

“Oh yeah, definitely and, you know, they were, it’s just to kind of stay on track, otherwise ...I mean that’s what’s really isolating about being a mum (P11)”

“...So you’ve got a person you can really just chat to and I guess it’s a bit of a vent time as well, like to talk about how you’re going with eating and I suppose I was like Oh am I on track or off track? (P09)”

“At that stage, you know, my son was a lot younger and it was hard logging in every day or after a meal to work out how many calories I was eating (P04)”

“To log on to the computer’s a bit difficult, but now that I’ve got a smartphone, it’s probably easier to log on to that (P03)”

“...I logged on to the app and never went back to the website (P11)”
“Yeah so unless I can do it on the phone, you’ve got no chance of getting me to sit down at a computer and do things (P10)”

“I found that by having the app on the phone, I could do it on the train, and just start keeping track of it, like daily (P02)”

“…the iPhone was probably a bit easier, because that’s always around me (P08)”

“Yeah I found it a little bit difficult because I’m the kind of person that I just eat kind of what I want without thinking about it and it was hard to work out the calories… it was hard logging on every day (P04)”

“I guess the only downfall for me was the actual counting of the calories (P06)”

“You could just count calories and lose weight. So that was good and I got the results with it. I probably lost… like at first I probably lost about five kilograms (P11)”

“At the start, I kind of looked into the recipes and the tracking side of it, but then it just sort of got a bit too much (P08)”

“… each night for a while I was sitting down and logging all my food and yeah, tracking my calories in and out (P12)”

“Yeah the book. That one was very helpful because I can check before I go do some shopping (P01)”

<table>
<thead>
<tr>
<th>(iii) Walking</th>
</tr>
</thead>
<tbody>
<tr>
<td>“...like a combination of doing this whole program and you know, doing it for stress relief (walking) has made me realise how much I enjoy it (P07)”</td>
</tr>
<tr>
<td>“Exercise wise, well I guess with the program, it’s made me more conscious, even if it’s a five minute walk around the block, that’s something, right? (P09)”</td>
</tr>
<tr>
<td>“I get off the train early just so that I walk further to and from work (P12)”</td>
</tr>
<tr>
<td>“...if it’s sunny and it’s good weather I always take the pram and walk to the shops rather than drive (P07)”</td>
</tr>
<tr>
<td>“... actually saying ‘we’re going to walk there, we could drive, but we’ll walk’ (P10)”</td>
</tr>
<tr>
<td>“... and I choose to walk really, really far because [my child] quite enjoys the walk, but he doesn’t really enjoy being in shopping centres or anything, but he quite enjoys a walk and then he might fall asleep and I can do the shopping while he’s asleep or, you know, that sort of thing and it just fills in the day and I get a bit of movement (P11)”</td>
</tr>
<tr>
<td>“I’ve got a friend from mothers group, that we go walking every week with the kids in prams (P12)”</td>
</tr>
</tbody>
</table>
(iv) Self-monitoring

“...but you know, it’s very important for our health not to gain too much weight after having a baby. So I think it’s very good to control my weight (P01)”

“...my personal trainer says don’t weigh yourself, and I’m like, Oh, I kind of like weighing myself... (P02)”

“I’ve never really been one to weigh myself. For me it’s if I fit nicer into my jeans this week (P03)”

“A familiar piece of clothing is probably the standard by which I kind of go, am I wider or narrower than I used to be? (P10)”

“...’cause you can tell by jeans and things, but I haven’t actually looked at that tape measure for a while (P04)”

“For me, waist circumference measurement is far more accurate than weight (P03)”

“...I reckon the waist ratio is a much better indication of health than using BMI... so yeah, I think the waist circumference measurement is very important (02)”

“....the measuring tape) was a bit of an eye opener, so that was good to have... it was good to have the visual and really understand OK, it’s probably not as good as I would have hoped, but knowing that is better than not knowing (P08)”

“I did measure it (waist circumference) and I was horrified... even before I had [my child] I had a really good waistline and then after having her, it’s funny how fat shifted to my waist... my figure has changed (P06)”

“I was surprised I was in a good weight range but my waist circumference was still, I think, in the orange area (P06)”

“So for me it’s more a focus of I need to eat better to stay healthier, but not so much weight related – if that makes sense? (P09)”

“....because I started taekwondo at the time and I could see, I could feel and see a change anyway, so I didn’t really measure myself, because I knew I had a big change anyway (P04)”
(v) Barriers and challenges

“So it was just more time, for me, with being a new mum, and my husband works seven days a week, so it’s pretty much me all the time, so I think in my situation, it was a bit tricky to find time for myself (P08)”

“’cause you think as a first time mum, it’s all about your baby and worrying about their meals, you don’t really have time...you feel bad about having time for yourself to think about it... (P08)”

“Actually because you know, when you are a fulltime mum you have to look after the baby and the kids and then yeah, I didn’t have time to go on the internet, sometimes, I just have no time (P01)”

“With a baby, I’m not going to take like the time to sit in front of a computer over and above doing anything else... (P11)”

“...I know there are lots of ways of being fit and working particularly abdominal muscles and things would put me in a good stead for future pregnancies, but there’s a certain amount of Oh my goodness, can I be bothered? (P10)”

“Maybe if I can find a friend to do the exercise, having motivation, like having a friend to go to the gym or having a friend to do the walking, outside walking (P01)”

(vi) Future recommendations

“...if you were sort of with people that were involved as well, you know, you might be able to discuss what you do and what they do and you know, just bounce ideas and things (P05)”

“So yeah, probably a little online community that you can check in with, whenever you feel you need to (P11)”

“So I’d say even though the CK app is good, I’d say if you were going to do it next time, if someone’s able to be a friend and then watch what you’re eating then you’ve got a consequence (P02)”

“Like if someone said ‘Oh well there’s a walking group that meet once a week in (X)’, that’s just and option if you want to do it (P09)”

“...you know, ask mums to join the group. Like for me, I’d get more motivation, maybe I can ask another mum to do the exercise and we work out together (P01)”
……you know, activities that you can try and do with a small baby, I kind of think, what exercise can I do with her in tow…(P96)”

“So probably on Facebook would have been handy, because you can use it on your phone, it’s a bit of a reminder and that’s exactly why I have it; for the parenting stuff, at the moment (P11)”

“So maybe like a more frequent call would have been. I don’t know, kept me on my toes a little bit more. Even like once a month or something (P12)”

“Maybe if there was a hotline to call into. Like I think it’s useful to have someone checking up to see how you’re going…so yeah if it was a larger scale project, more staffing calls (P10)”
Theme (i) Program usefulness

Several of the mothers who completed the intervention found it to be helpful in terms of assisting them with being generally healthy. For example, “…I found it all pretty good and supportive and yeah, I didn’t even know that programs like this existed before I had [my child], so it was good to be part of it (P07)” and “…so with the mums OnLiNE I thought well I’m already doing this and, you know, it’s a good thing, it’s obviously extra help for me so it’s not like something that’s going to take a lot of time out, sort of thing (P09)”.

One mother made reference to the dietary intake tracking component of the program being useful not only during the intervention period but potentially also in the future by stating “So, I feel like as a lifestyle thing it’s helped and I feel like maybe in the future I’ll be able to go back to those tools and help with the calorie counting side of it (P08)”. On the other hand, one woman found the program to not be useful overall, mostly due to the web-based delivery of the program. She stated “Yeah look to be honest, I’m not big on the internet…I probably didn’t get a lot out of it to be 100 per cent truthful (03)”.

Regarding attitudes towards awareness of healthy eating and PA, the majority of the mothers reported that the mums OnLiNE intervention assisted with improving their awareness towards healthy eating. For example “…I’m just more aware and I guess if some days we eat a bit of crappy food, I’ll make sure that the next couple of days we eat well and yeah, a bit more balanced and more aware of what I have eaten over the week (P07)” and “I just feel like I’m more aware now of what I’m eating and like I kind of look at a big bowl I’m having of pasta, for example and I’m kind of a bit more aware of that (P08)”. The same mother went on to state “I think it’s been really helpful and it’s kind of, it’s all been a good way to think about your eating all the time, not just crash dieting type programs (P08)”. She also reported that her awareness to drink more water had improved by stating “I found I wasn’t drinking that much water, and that kind of made me more aware of it as well (P08)”.

In addition, some mothers reported that the intervention assisted with improving their PA awareness. For example “It probably made me think of useful things like I haven’t been out for a walk and it often still does, now. I think Oh I didn’t get out for a walk today, you know, ‘cause you get busy with your washing and your cleaning and doing stuff…(P09)”. Another mother reported that the intervention had helped with increasing her awareness to be less sedentary. She stated “I can do little things around the house, even [the dietitian] was saying things like
when you’re folding the washing, to stand up instead of sitting down all the time...so just being more aware of not sitting so much... (P08)”.

A few women reported that the mums OnLiNE intervention assisted more with support overall, and it was useful from a support perspective and helping them prioritise their own health and their own needs. For example “...because I felt very alone and that, so that just gave me a contact. So I think deep down it was beneficial, yeah (P04)” and “It still felt like I was, I had to leave Melbourne and I left all my friends behind and the mums group that we’d just started and so I felt like I was leaving a lot, but then I still had this, so yeah, it made me feel part of everything again and that was good for me (P07)”.

A different mother stated “...a while after I had my son, I did struggle just putting myself as a priority full stop and you feel like you have to clean the house, you have to do this, you can’t exercise because of all these other things, but I got to a point I just said ‘No’, I actually have to do it to look after myself ‘cause I can’t do all of those things if I’m not healthy (P12)”.

Theme (ii) Intervention components

There was wide variation in women’s views regarding the intervention components. All women found the phone calls with [the dietitian] to be useful and three mothers specifically stated that they preferred this part of the intervention to other components. One woman stated “I think the phone calls with [the dietitian] were probably the best because you are able to check and validate things (P02)”.

The other mothers said “…but certainly the phone calls are probably the most, for me, particularly most beneficial because you can just talk about what’s current at the time (P03)” and “I think the most useful was the phone calls. And [the dietitian] is lovely and easy to talk to so that was helpful as well (P08)”.

Several mothers reported that the phone calls were important for increasing motivation or for remaining motivated. For example, “…I think just that motivation and being able to touch base with someone was the most important (P012)” and “She [the dietitian] was really good to talk to and I think, I’ve got all the tools that I need to achieve what I want, I just needed the motivation (P06)”. One other mother stated “…and having her [the dietitian] ring, though, you know I’d start to get a little less motivated and then she’d ring and then, you know, my motivation would get back up…it just boosted my motivation a little bit just talking about it (P07)”.

Further, a few mothers reported that the phone calls were useful for generally
‘keeping on track’ with goals or individual targets or particular aspects of the program overall. One mother said “...because sometimes I forgot about the program, because, you know, I got busy, but when she [the dietitian] calls, I remind myself that ‘Oh I have to get back on track again (P01)’”. Other mothers stated “Oh yeah, definitely and, you know, they were, it’s just to kind of stay on track, otherwise...I mean that’s what’s really isolating about being a mum (P11)” and “…So you’ve got a person you can really just chat to and I guess it’s a bit of a vent time as well, like to talk about how you’re going with eating and I suppose I was like Oh am I on track or off track? (P09)”.

Mothers expressed a range of views towards other intervention components. Whilst a few mothers referred to the website being a helpful intervention component, there seemed to be a tendency for mothers who used the online components frequently to prefer the smartphone app as a more convenient method of tracking diet and/or PA. For instance, one mother stated “At that stage, you know, my son was a lot younger and it was hard logging in every day or after a meal to work out how many calories I was eating (P04)”. Other mothers said “To log on to the computer’s a bit difficult, but now that I’ve got a smartphone, it’s probably easier to log on to that (P03)” and “...I logged on to the app and never went back to the website (P11)” and “Yeah so unless I can do it on the phone, you’ve got no chance of getting me to sit down at a computer and do things (P10)”. Overall, mothers found using the smartphone application more suitable as these were often close at hand and could be used with ease in different circumstances. For example, one mother said “I found that by having the app on the phone, I could do it on the train, and just start keeping track of it, like daily (P02)”. One other mother responded “…the iPhone was probably a bit easier, because that’s always around me (P08)”.

Views of recording diet and calorie intake differed. Two mothers found it to be arduous. For example “Yeah I found it a little bit difficult because I’m the kind of person that I just eat kind of what I want without thinking about it and it was hard to work out the calories...it was hard logging on every day (P04)” and “I guess the only downfall for me was the actual counting of the calories (P06)”. On the other hand, one mother stated specifically that this method was beneficial for weight loss. She said “You could just count calories and lose weight. So that was good and I got the results with it. I probably lost...like at first I probably lost about five kilograms (P11)”.
Frequency of use of the intervention components varied amongst the mothers. Use of the website ranged from ‘hardly ever’ to ‘a lot’, with a few women reporting their use decreased as the intervention period progressed. For example, one mother reported “At the start, I kind of looked into the recipes and the tracking side of it, but then it just sort of got a bit too much (P08)”. Use of the smartphone application followed a similar pattern, yet one mother reportedly used the app to track her dietary intake and PA on most days. She said “…each night for a while I was sitting down and logging all my food and yeah, tracking my calories in and out (P12)”. Interestingly the majority of women either never used the blog or used it on one occasion only. Two women reported using the calorie counting booklet frequently. One mother reported the book being useful to use in deciding which healthy foods to purchase. She said “Yeah the book. That one was very helpful because I can check before I go do some shopping (P01)”.

Theme (iii) Walking

Many of the mothers had positive views regarding walking as a suitable and enjoyable form of PA. Some mothers reported that the mums OnLiNE program had made them more conscious of walking and that their walking had increased as a result. For example “…like a combination of doing this whole program and you know, doing it for stress relief (walking) has made me realise how much I enjoy it (P07)” and “Exercise wise, well I guess with the program, it’s made me more conscious, even if it’s a five minute walk around the block, that’s something, right? (P09)”. Some mothers specifically mentioned incidental walking as a priority and reported that they had incorporated walking into their usual, busy lives. One mother stated “I get off the train early just so that I walk further to and from work (P12)”. Other mothers stated “…if it’s sunny and it’s good weather I always take the pram and walk to the shops rather than drive (P07)” and “…actually saying ‘we’re going to walk there, we could drive, but we’ll walk’(P10)”.

Some mothers reported taking their babies walking and that it was a pleasant and convenient experience for both women and children. One mother reported “…and I choose to walk really, really far because [my child] quite enjoys the walk, but he doesn’t really enjoy being in shopping centres or anything, but he quite enjoys a walk and then he might fall asleep and I can do the shopping while he’s asleep or, you know, that sort of thing and it just fills in the day and I get a bit of movement (P11)”. A few mothers specified that they walked with another
mother or with a group of mothers from their first time mothers group, usually with their children. Some mothers scheduled regular walking times with others. For example, “I’ve got a friend from mothers group, that we go walking every week with the kids in prams (P12)” and “…and last summer with mothers group, we did a fair bit of walking, we would meet once a week, you know, go for a walk or whatever (P04)”. In addition, one mother reportedly used the pedometer to make her more conscious of being active and walking specifically. She said “I did use the pedometer. I do loads of steps… it just gets you conscious of what you’re doing as well (P03)”.

Theme (iv) Self-monitoring

There was variation in the responses to how frequently women self-monitored weight and/or WC. Responses ranged from weighing once to almost daily and for WC, from never, to several times throughout the intervention period. Women’s views regarding the importance of self-monitoring differed, however many mothers considered the overall measurement of weight to be important. For example, one mother stated “…but you know, it’s very important for our health not to gain too much weight after having a baby. So I think it’s very good to control my weight (P01)”. One mother reported enjoying self-monitoring of weight despite advice from her personal trainer not to weigh herself. She said “…my personal trainer says don’t weigh yourself, and I’m like, Oh, I kind of like weighing myself…(P02)”. On the other hand, three mothers reported that they self-monitored weight by being aware of how their clothing was fitting, rather than monitoring actual crude weight measurements. They stated “I’ve never really been one to weigh myself. For me it’s if I fit nicer into my jeans this week (P03)” and “A familiar piece of clothing is probably the standard by which I kind of go, am I wider or narrower than I used to be? (P10)” and “…’cause you can tell by jeans and things, but I haven’t actually looked at that tape measure for a while (P04)”.

Several mothers considered WC to be a more useful measurement compared to weight. For example “For me, waist circumference measurement is far more accurate than weight (P03)” and “…I reckon the waist ratio is a much better indication of health than using BMI… so yeah, I think the waist circumference measurement is very important (02)”. In addition, two women mentioned that they had noticed an increase in central adiposity following pregnancy and that monitoring WC had assisted with the realisation. They stated “…(the measuring tape) was a bit of an eye opener, so that was good to have…it was good to have the visual and really
understand OK, it’s probably not as good as I would have hoped, but knowing that is better than not knowing (P08)” and “I did measure it (waist circumference) and I was horrified...even before I had [my child] I had a really good waistline and then after having her, it’s funny how fat shifted to my waist...my figure has changed (P06)”. The same mother also said “I was surprised I was in a good weight range but my waist circumference was still, I think, in the orange area (P06)”.

Just two mothers expressed disinterest in weighing themselves, and that self-monitoring weight was not meaningful. One mother considered general healthy eating and feelings of well-being to be more important. She said “So for me it’s more a focus of I need to eat better to stay healthier, but not so much weight related – if that makes sense? (P09)”. The other mother stated “...because I started taekwondo at the time and I could see, I could feel and see a change anyway, so I didn’t really measure myself, because I knew I had a big change anyway (P04)”.

**Theme (v) Barriers and challenges**

By far, lack of time and lack of motivation were the most frequently reported barriers to being engaged in the mums OnLiNE program, regardless of mothers’ individual goals or needs. Almost half of the sample of mothers reported lack of time in general as a challenge. One mother stated “So it was just more time, for me, with being a new mum, and my husband works seven days a week, so it’s pretty much me all the time, so I think in my situation, it was a bit tricky to find time for myself (P08)”. A few women stated that lack of time specifically due to child priorities was the main barrier to engagement. For example “’cause you think as a first time mum, it’s all about your baby and worrying about their meals, you don’t really have time...you feel bad about having time for yourself to think about it... (P08)”. Other mothers reported “Actually because you know, when you are a fulltime mum you have to look after the baby and the kids and then yeah, I didn’t have time to go on the internet, sometimes, I just have no time (P01)” and “With a baby, I’m not going to take like the time to sit in front of a computer over and above doing anything else...(P11)”.

Almost half of the sample of mothers reported lack of motivation as a main barrier, particularly in regards to being physically active, even though they were aware of the health benefits of exercise. One mother said “...I know there are lots of ways of being fit and working particularly abdominal muscles and things would put me in a good stead for future pregnancies, but there’s
a certain amount of Oh my goodness, can I be bothered? (P10)” A different mother reported that having a friend to exercise with would have helped with her motivation levels. She said “Maybe if I can find a friend to do the exercise, having motivation, like having a friend to go to the gym or having a friend to do the walking, outside walking (P01)” Fewer women reported that rain or poor weather were barriers to PA and that having to work in paid employment was a barrier to being engaged in the intervention. Two women reported being challenged due to not having access to a desktop computer on a regular basis.

Theme (vi) Future recommendations

Views regarding recommendations for future support to assist first time mothers in attaining healthy postpartum weight and healthy diet and/or PA behaviours were varied. The most commonly reported recommendation was for group based participation. One third of the sample suggested group based participation would be beneficial, and some mothers had a preference for face-to-face interaction whereas a few mothers specified online or app based integration with other new mothers. One mother stated “if you were sort of with people that were involved as well, you know, you might be able to discuss what you do and what they do and you know, just bounce ideas and things (P05)” Other mothers stated “So yeah, probably a little online community that you can check in with, whenever you feel you need to (P11)” and “So I’d say even though the CK app is good, I’d say if you were going to do it next time, if someone’s able to be a friend and then watch what you’re eating then you’ve got a consequence (P02)” Two mothers outlined that group support and interaction would assist with PA specifically. For example “Like if someone said ‘Oh well there’s a walking group that meet once a week in (X)’, that’s just and option if you want to do it (P09)” and “…you know, ask mums to join the group. Like for me, I’d get more motivation, maybe I can ask another mum to do the exercise and we work out together (P01)” In addition, one mother recommended exercise classes with babies and highlighted that some education or ideas regarding the types of exercises a mother can do with a baby would be useful. She said “…you know, activities that you can try and do with a small baby, I kind of think, what exercise can I do with her in tow...(P06)”.

Further, a few mothers recommended that future programs like the mums OnLiNE intervention continue to integrate a smartphone app as part of the intervention delivery or for tracking diet and PA. A few mothers also recommended that future programs incorporate weekly reminders
or prompts, to log on to the app or website, such as email reminders or SMS reminders. Two mothers specifically mentioned that Facebook would be a useful component, with one mother referring to Facebook as being useful for regular reminders about the program. She said “So probably on Facebook would have been handy, because you can use it on your phone, it’s a bit of a reminder and that’s exactly why I have it for the parenting stuff, at the moment (P11)”.

Few mothers mentioned additional phone call services (either increased frequency or a line mothers could call as needed) would be useful as additional support. One mother said “So maybe like a more frequent call would have been, I don’t know, kept me on my toes a little bit more. Even like once a month or something (P12)”. Another mother stated “Maybe if there was a hotline to call into. Like I think it’s useful to have someone checking up to see how you’re going...so yeah if it was a larger scale project, more staffing calls (P10)”. Other occasionally proposed strategies for future programs included initiation of a program during pregnancy and running it throughout the postpartum period, a weight loss ‘challenge’, and face-to-face contact with the interventionist.

6.5 Discussion

This study has shown that first time mothers are supportive of practical strategies to assist them in attaining healthy lifestyles during the postpartum period. Despite results from the mums OnLiNE intervention having indicated that the program was not effective in improving diet and PA behaviours, results from this study suggest that for many women, their awareness of healthy eating and PA, including incidental PA, their motivation to be healthy, and the importance they placed on attaining healthy postpartum weight, had increased as a result of their participation. In addition, and importantly, this study provided a deep understanding of the needs of first time mothers and their preferences for future, similar programs to assist women in achieving healthy lifestyle behaviours during the postpartum period.

Whilst there were mixed views regarding those aspects of the mums OnLiNE program that women perceived as being most helpful, overall women found the one-on-one telephone counselling calls to be by far the most valuable component of the intervention. Mothers reported that the calls assisted in increasing motivation, giving them a sense of accountability and providing assistance in prioritising their own health. These results are similar to those found by Bertz et al (595), whereby women reported that being monitored and feeling
accountable through weekly mobile telephone text message prompts assisted with motivation to attempt postpartum weight loss (595). Similar views regarding telephone support were reported in a separate, qualitative study in the UK, which explored the needs of first time mothers regarding support with adjusting to motherhood (596). When face-to-face contact was unavailable, telephone counselling calls were considered an important component of postpartum care and provided reassurance to mothers in the early months following childbirth (596). Considering mothers themselves view telephone counselling as a useful and valuable means of receiving advice and tailored support, when used alongside other intervention components, telephone support calls could have potential to assist women to be motivated and empowered to make healthy lifestyle changes.

Broadly, there is evidence supporting the efficacy of telephone delivered interventions aimed at promoting dietary and/or PA behaviour change and weight loss in a variety of settings and target populations (571, 572, 597-599). Whilst further studies are needed to assess the role of telephone support in programs aimed at reducing PPWR, results from the current study suggest the potential effectiveness of utilising telephone support as part of postpartum interventions. Despite telephone calls during the mums OnLiNE intervention period being relatively infrequent compared to other studies which have employed telephone support to target PPWR (322, 330), just one mother in the current study reported a preference for more frequent scheduling of calls. Further research should explore the preferred frequency of telephone calls, to ensure a balance between provision of adequate support, whilst ensuring responsiveness to the time constraints commonly faced by new mothers during the postpartum period.

Interestingly, the results of this study showed that mothers’ use of the commercially available website was intermittent and sporadic. Whilst some mothers found the website useful, few actually used the website regularly. Despite mixed views towards the usefulness and convenience of tracking daily calorie targets, generally mothers who did so on a regular basis found this function more practical when done by using the smartphone app rather than the website. Mothers found the app to be more accessible and convenient than the website and could easily record dietary intake and PA data progressively at different times throughout the day, rather than being restricted to using a desktop PC to access the website. Preference for easily accessible functions to assist weight management has been reported elsewhere. For example, a recent qualitative study conducted in the UK, explored the perceptions of adults regarding the use of smartphone apps for weight loss (600) and found that accessibility of
information which could be read easily, ‘on the go’ and in most locations, and which allowed for self-monitoring and goal setting in ‘spare minutes’ was a highly appealing feature (600).

The increasing number of smartphone apps available has revolutionised the way in which information can be accessed and delivered (601). Used specifically for the purpose of delivering interventions to target healthy weight and healthy behaviour change, apps have the potential to be wide reach with significant population-based utility. For example, in Australia, approximately two thirds of adults (68%) own a smartphone (321, 602). With associated costs of owning a smartphone reportedly decreasing (321), it has been estimated that in 2-3 years almost every Australian adult will own a smartphone (321, 602), which will ultimately increase accessibility to apps. In the US, smartphone subscription is also increasing (427) and access to mobile phones in general is high, with roughly 90% of mobile phone users in the US being in possession of their mobile phone 24 hours a day (603).

Specifically for new mothers, mobile devices (used to access a range of apps) have been regarded as beneficial in offering the opportunity to access information during the middle of the night, assisting women to stay awake whilst feeding (553), or as an opportunity to unwind after settling a fractious infant (553). Use of smartphones can offer an extension of a woman’s social life and allow for continued interaction with friends, even when women are housebound or attending to domestic tasks related to motherhood (604). Utilised in this way, smartphone apps have potential to optimise flexibility and convenience to suit the often hectic lives of new mothers; a vital component in maximising engagement.

Despite a lack of evidence in this area to date (605), results from intervention studies which have utilised smartphone apps as part of their delivery have shown some promising results with respect to weight loss (336), promoting healthy dietary intakes (606) and increasing PA (607) in a variety of adult populations. In particular, smartphone apps have been regarded as important elements during the transition to first time motherhood (604). However, as the usefulness of smartphone apps to limit PPWR is relatively unknown, further qualitative research and postpartum intervention studies are warranted to assess their potential effectiveness.

As both Chapter 4 (4.4.2) and Chapter 5 (5.8.4) showed, and consistent with the literature (326, 592), walking is a popular activity for first time mothers and many women appear to be
frequently engaged in walking as a preferred form of PA during the postpartum. Mothers in this study reported walking to be beneficial and enjoyable, and that their awareness of opportunities for incidental walking had increased, as a result of their participation in the mums OnLiNE program. These findings are positive as whilst the intervention results did not show significantly increased time spent walking, some women reported that their time spent walking did increase and that they had become more conscious about windows of opportunity to incorporate walking into their daily lives.

Consistent with findings from elsewhere (592), women in this study had positive views towards walking in a variety of contexts. They regarded walking as a highly suitable activity during this stage of their life, reporting walking often with other mothers and with their babies. Mothers expressed a view that walking groups would be a useful consideration for future interventions. Women reported that this would assist motivation and group support. This is consistent with an earlier qualitative study, which assessed new mothers’ views of exercise during the postpartum (592). Findings from that study showed that being able to walk with a friend or another woman with a new baby was regarded by new mothers as an important facilitator for walking participation (592). Considering that walking is flexible, convenient and is low cost (592), implementing a focus on walking groups as part of postpartum interventions aimed at increasing PA may be logical and has potential to be cost-effective and facilitate group interaction and social support. In addition, promoting PA via mother-baby exercise classes (608) might be a potentially effective strategy for optimising PA in new mothers.

There was variation in the views and attitudes of women in regards to the usefulness of self-monitoring weight and WC, the reported frequency of self-monitoring and the importance placed on self-monitoring in general. Despite mothers reportedly self-monitoring WC less often than weight, many women considered WC a more meaningful measure than weight or BMI in terms of postpartum weight status and overall health. This finding may have important implications for future interventions targeting PPWR. As has been previously discussed throughout this thesis, WC is an important assessment of postpartum weight status due to the majority of weight being retained centrally, as opposed to viscerally, for most women (220, 524, 609). Higher than recommended WC measures as was evident for many women enrolled in the mums OnLiNE intervention, carries increased risk for several chronic diseases such as CVD and T2DM (610), independent of whole body adiposity (610-612). Making women aware
of this association could be an important part of motivating women to attain healthy WC measures, and to do so with the aid of regular self-monitoring.

Very few women in this study reported accessing the mums OnLiNE blog throughout the intervention period, with no specific reasons for this being provided. However, Facebook was suggested by women as a potential means of support for future programs. It has been estimated that 80% of Australian mothers use Facebook daily (538, 613) and for many women, Facebook is their primary means of staying connected with family and friends (538, 613). Specifically, postpartum women are frequent users of Facebook (263, 538, 614), with their use of the site having been found to increase with the transition to parenthood (263, 538). This might offer a unique approach to delivering program information to new mothers, facilitating group interaction and support and increasing motivation, when used alongside other intervention components.

Online social networking sites such as Facebook have great potential for the delivery of low cost, flexible and wide reach, health interventions (613, 615). To date, however, very few studies have used Facebook to deliver health behaviour interventions (263). Results from a recent Australian study, the Mums Step It Up Facebook Program, showed that utilisation of Facebook in a team based PA intervention was successful in significantly increasing weekly PA time. Women used Facebook to log walking steps, monitor progress and interact with team members (613). Whilst further studies including RCTs are needed to assess the effectiveness of Facebook in promoting healthy lifestyle behaviour change, these results are promising and highlight an opportunity for the use of social networking to encourage healthy behaviours in new mothers.

Undoubtedly, the greatest barrier to mothers being engaged in different aspects of the mums OnLiNE program was a lack of time. Mothers reported a lack of time in general, but also specified a lack of time due to attending to child duties. This is not surprising, as previous literature has consistently identified time constraints as a result of having children to be a major barrier to healthy eating (279), PA (451, 452) and participation in postpartum weight-loss programs (434). Furthermore, women struggle with prioritizing their own health. This is supported by findings from this study and also previous qualitative studies conducted with mothers (434, 594, 595). New mothers frequently give precedence to multiple responsibilities and put the health of their baby first, even at the expense of improving their own health (434).
Women have described the overall experience of attempting to lose weight during the postpartum period as one of achieving a balance between their various life roles (400). Therefore addressing this issue is a key component in the adequate provision of support for new mothers during the postpartum period. Reassurance and assisting mothers with the realization that their own health is an important consideration is vital. Strategies should be employed to ensure women are receptive to prioritising their own health during the postpartum period. This is challenging, yet crucial, in planning future work to address healthy maternal weight, if mothers are to be successfully engaged in healthy lifestyle programs.

6.6 Strengths & limitations

This is one of only few qualitative studies to have explored the views and perspectives of women who took part in a postpartum intervention aimed at limiting PPWR and promoting healthy lifestyle behaviours. Moreover, it is one of very few studies to have documented the suggestions and recommendations regarding new mothers’ needs and preferences for provision of weight related support following childbirth. This study therefore offers unique and valuable information regarding assessment of a postpartum intervention, as well as informing the future planning of supportive strategies targeting first time mothers.

It is important to acknowledge this study had limitations. The overall views and opinions of mothers who took part in this study may have been more positive towards the intervention than those of the women who elected not to participate, which could in part, account for their willingness to offer information and participate in the interviews in the first place. Evaluation of the mums OnLiNE program, the intervention components and overall reported engagement may have been somewhat different had all women participated in an interview. Further, women who took part in this study were predominately highly educated and of mid to high household income. As barriers to engaging in healthy behaviors and recommendations regarding supporting strategies for postpartum women may differ amongst less educated or lower SEP women, qualitative work which seeks to obtain insight into views and perceptions of women of varied education levels and across a range of SEP levels should be a consideration for future work.
6.7 Conclusion & implications

This chapter has detailed a qualitative study with first time mothers who recently completed the mums OnLiNE pilot intervention study. Overall, mothers felt supported being part of a healthy lifestyle program and valued the care provided during a demanding and vulnerable stage of their lives. Many mothers reported feeling more aware of eating healthily and participating in PA as a result of participating in the mums OnLiNE program. Specifically, women reported being more engaged in incidental walking and incorporating walking more easily into their daily lives.

Overall, the one-on-one telephone calls with the dietitian were considered the most valuable component of the mums OnLiNE program, in encouraging women to be healthy and in fostering engagement throughout the intervention period. In terms of online support, the smartphone app was used more frequently than the web-based program and women regarded the app as being more useful than the website due to convenience and flexibility of access.

Undoubtedly, first time motherhood is accompanied by multiple adjustments and new responsibilities. Women are often time poor and frequently prioritise their child’s health over their own. Interventions aimed at promoting healthy maternal weight, dietary habits and PA behaviours must address the multiple barriers women face during the postpartum period. Recommendations, such as those offered by mothers in this study, including integration with Facebook and promoting group interaction and social support, should be considered in planning future programs to support new mothers.

This qualitative study has provided valuable information reported by first time mothers regarding their views and attitudes towards opportunities to assist healthy postpartum weight, diet and PA. The following and final chapter summarises the major findings of this thesis, highlights some of the important implications which have arisen from this work and describes how findings from this thesis may inform future research.
Chapter 7
Summary and conclusions

7.1 Overview of findings

This thesis described the methodology and presented the findings of four unique studies. The first two studies provided insight into the current clinical management of GWG and provision of advice regarding maternal weight and healthy lifestyle behaviours across the perinatal period. Findings from Studies 1 and 2 informed the design and implementation of Study 3, the mums OnLiNE postpartum pilot intervention delivered to first time mothers. Study 4 detailed a qualitative assessment of the mums OnLiNE intervention and identified opportunities for future support to assist women in attaining a healthy weight and healthy lifestyle behaviours following childbirth.

Findings from Study 1 (Chapter 3) indicate that GPs participating in shared antenatal care recognise many adverse health outcomes associated with excess GWG, yet approaches to management were shown to be inconsistent. Many GPs were reluctant to weigh women throughout pregnancy or monitor GWG, indicating management of maternal weight during pregnancy is not high on the antenatal healthcare agenda. Moreover, recommendations for GWG were infrequently provided. When advice was given to women regarding the amount of weight to gain during pregnancy it was found to vary widely. Many barriers to provision of support were reported by GPs, however time constraints and a lack of knowledge regarding the appropriate weight to recommend were the most common barriers.

Findings from Study 2 (Chapter 4) further supported inconsistencies in approaches to management of maternal weight across the perinatal period. Despite a shift in mean weight towards a higher BMI from pre-pregnancy to the postpartum, many first time mothers reported they received no advice from their healthcare provider regarding healthy GWG and an even higher proportion of women received no weight related advice by three months postpartum. The study also showed that fewer women reported receiving healthy diet or PA advice during the postpartum period than during pregnancy even though many women had suboptimal dietary intakes when compared with recommendations, and were insufficiently physically active.
Overall, when advice was provided to women, it did not promote healthy weight attainment or healthy lifestyle behaviours.

Design and implementation of Study 3 (Chapter 5) utilised findings from Studies 1 and 2. The intervention significantly improved WC measurements and PPWR, showing it is possible to assist women with attaining improved body composition following childbirth. These results support the wider literature (250) whereby interventions targeting PPWR including both diet and PA components, rather than just one of these, are more likely to be successful in promoting healthy maternal weight. Interestingly, findings from Study 3 showed that the mums OnLiNE intervention did not significantly improve diet, PA, sedentary behaviour or self-efficacy in first time mothers. The measurement tools used to assess these behaviours had some limitations and these were discussed in Chapter 5 (5.10), which may have contributed to significant differences between the intervention and control groups not being observed.

As reflected by the findings from Study 4 (Chapter 6), new mothers held positive views and valued the support they received by taking part in the mums OnLiNE intervention. Many women reported increased awareness for healthy lifestyle behaviours as a result of participation in the mums OnLiNE program. They also reported that lack of time was a significant barrier to engagement in the program, which is consistent with the few studies that have explored barriers to healthy eating (279) and PA (452) in mothers. The findings from Study 4 highlight that new mothers may often struggle to prioritise their own health due to demands in caring for their newborn. This underscores the importance of assisting women to acknowledge that their own health should be considered equally important to their child’s health.

7.2 Implications & future directions

The findings presented in this thesis have important implications from a public health perspective and have assisted with the identification of specific target areas for future research. This thesis has assisted with identifying opportunities for enhanced provision of support by healthcare providers across the perinatal period, as well as strategies aimed at improving maternal weight, diet and PA habits through lifestyle interventions.
7.2.1 Clinical management

Results from Studies 1 and 2 have identified a distinct gap in the current provision of weight advice and healthy lifestyle support provided to women during pregnancy and following childbirth. This is consistent with findings from the limited body of research to date (418, 419). As a high proportion of women are in regular face-to-face contact with their antenatal healthcare provider throughout their pregnancies, multiple opportunities exist for healthcare providers to engage with women regarding healthy weight and healthy lifestyle behaviours. However, despite recognising the adverse health implications of excess GWG, healthcare providers such as GPs report many barriers to providing women with consistent GWG advice and with support to attain a healthy weight during pregnancy. From the perspective of many GPs interviewed in Study 1, alternate clinician support such as a referral scheme to allied healthcare providers would alleviate consultation time restraints and assist with developing management pathways and a guaranteed approach to managing ‘at risk’ women during their pregnancies. Further work is needed to assess the suitability, feasibility and cost effectiveness of such an approach.

Findings from both Studies 1 and 2 indicate that, for many women who become pregnant, their antenatal healthcare provider might be an unreliable source for promoting healthy pregnancy weight gain. Inconsistencies in the management of GWG provided by GPs is likely to continue to impact both maternal and foetal obstetric outcomes resulting from excess GWG as well as the increased financial burden associated with the provision of antenatal care for women who are overweight or obese (63, 616). Almost half of all women in the sample of first time mothers recruited to Study 2 gained weight in excess of IOM guidelines for GWG. On average, compared to women with a healthy BMI, those who were overweight or obese experienced excess GWG more frequently. The implementation of formal guidelines for GWG may assist in ensuring a more consistent approach to management as past studies have shown that when women are given specific targets for GWG, they are more likely to achieve weight gain within the healthy range (387). Yet, whether formal GWG recommendations will be introduced in Australia is uncertain.

During the postpartum period women reported receiving weight advice far less often than during pregnancy as indicated by the results of Study 2 (Chapter 4). In a similar vein, advice regarding a healthy diet and PA does not appear to be a priority for healthcare providers,
reflected by the high proportion of women in Study 2 who had not received any such advice by three months postpartum. This is despite (as evidenced by findings from Studies 2 and 3) the fact that many women are heavier, have higher than recommended central adiposity, achieve suboptimal fruit and vegetable intakes and are insufficiently physically active during the postpartum period. From a public health perspective, these findings are concerning. As well as the many documented health benefits of achieving optimal fruit and vegetable intakes (256) and adequate PA (263) during adulthood, the inter-pregnancy stage has been regarded as a crucial period to target weight-loss, particularly in women who are obese (216), with the purpose of optimising maternal and neonatal outcomes during subsequent pregnancies. In addition to positively impacting maternal health, inter-pregnancy weight-loss, particularly for obese women, has further potential to impact long term child health by presenting the offspring with a healthier start to life (216).

If healthcare providers are to play a key role in intersecting the propensity for women to experience weight gain across the perinatal period, structural modifications to the current postpartum care regime are required. This might consist of formally scheduled mother-focused health consultations in the months following childbirth. However feasibility of implementing continued care for women from pregnancy into the postpartum period would need to be assessed. Opportunities for healthcare providers to engage women during the postpartum would be increased through more frequent face-to-face appointments, yet this would likely result in increased financial strains placed on the current healthcare system. Future work would require an economic assessment of such approaches whilst qualitative work would be useful to further ascertain how healthcare providers feel postpartum support could be integrated feasibly into the current healthcare system. Further qualitative work with mothers would be beneficial to assess their views and perspectives regarding clinician delivered support during the postpartum period.

As evidenced by results from Study 2 (Chapter 4) when advice was provided to women by healthcare providers it did not positively influence healthy maternal weight or healthy lifestyle behaviours. Whilst the type of advice provided to women was not assessed, it is an important consideration for future research. Postpartum weight, diet and PA advice delivered routinely and consistently across healthcare providers and in line with recommendations, might be influential in promoting healthy maternal outcomes. Research assessing broader factors that positively influence women to adopt healthy lifestyles during the postpartum period are needed.
to better understand the role of the healthcare provider in delivering weight-focussed support for women following childbirth.

7.2.2 Interventions and supportive lifestyle programs

Findings from Study 3 (Chapter 5) indicate that provision of support via lifestyle programs has capacity to engage women during the postpartum period. Despite difficulty encountered in recruiting women to postpartum interventions, as indicated by the relatively low uptake to the mums OnLiNE program and previous postpartum interventions (250, 251), postpartum interventions which engage women on a one-on-one level and which integrate technology for the purpose of convenience, such as the mums OnLiNE program, can be successful and suitably integrated to accommodate the often hectic lifestyles faced by new mothers.

Across all three groups at baseline WC measures exceeded recommendations (458). Even independent of BMI, WC at levels above recommendations are associated with increased risk for CVD (617). Despite some reduction in WC for both control groups being observed, by completion of the intervention mean WC measures were still above recommendations for these two groups. However, the mums OnLiNE intervention was successful in not only reducing WC significantly, but the mean WC measure at completion of the intervention was below the cut-off point of 80cm recommended for women (458). From a public health perspective this has significant potential impact in terms of reducing risk for insulin resistance, T2DM, dyslipidaemia and cardiovascular disease (478) in this population group. With CVD being the most significant contributor to female mortality in Australia (618), 90% of the general population of Australian women having at least one risk factor for CVD already (618), and with postpartum adiposity being centrally deposited for most women (218), postpartum women are a population sub-group who should be a focus of supportive weight-loss interventions. Even modest reductions in WC measures have been associated with reduced factors for poor cardiovascular health (478). Therefore, findings from the mums OnLiNE intervention have shown that it is possible to have a positive impact on a new mother’s risk for CVD.

The observed change in WC measures bode well for potential success of postpartum interventions implemented by combined online and telephone delivery and which include both diet and PA components. However the mums OnLiNE intervention did not appear to improve maternal diet, PA, sedentary behaviours or self-efficacy using the measurement tools.
described. As many women across all three groups of the mums OnLiNE study showed suboptimal dietary and PA behaviours, and were not meeting recommendations for health either at baseline or upon completion of the intervention, supportive programs that seek to improve such behaviours might be considered equally important as those which target reduced PPWR.

Results from Studies 2 and 3 and the wider literature have shown that large proportions of women do not meet recommendations for fruit and vegetable intake (430, 502). Furthermore, they do not achieve adequate levels of PA (619, 620) across the perinatal period. Therefore, in the interest of public health, future studies should aim to improve these habits both during and following pregnancy, with the intention of supporting best pregnancy outcomes and optimising both maternal and child health.

Findings from Studies 2, 3 and 4 and from elsewhere (326, 592) have consistently shown that walking is a highly popular and desirable form of PA for new mothers. As levels of walking appear to be already consistently high, compared to other forms of PA, promoting walking as being beneficial to health and implementing walking programs as part of future interventions might further assist in helping women achieve adequate or at least improved levels of postpartum PA. Increasing the opportunities for women to engage in walking and increasing their PA through strategies such as walking groups may prove to be a viable option and foster attainment of healthy postpartum weight.

Results from the mums OnLiNE intervention have provided some interesting insights regarding intervention length and also initiation of interventions during the postpartum period. Of the women who dropped out of the mums OnLiNE intervention, all but one woman needed to be withdrawn from the study due to becoming pregnant for a second time during the intervention period. To maximise participant retention rates, future studies might either recruit women earlier in the postpartum period or be of a shorter intervention duration to allow for maximum completion of the intervention, prior to a second pregnancy. Nevertheless, whilst the ideal stage of recruitment and intervention length remains uncertain, capitalising on the window of opportunity during the inter-partum stage is an important consideration in the planning of future interventions. Further, future qualitative work with mothers might assess the preferred and ideal timing of intervention delivery.
Despite women having previously been found to be more motivated to lose weight during the postpartum period, compared with during pregnancy (298), motivation does not necessarily foster high recruitment rates to postpartum interventions. The relatively low uptake of mothers to the mums OnLiNE intervention, as well as evidence provided by past studies (251) indicate women struggle to prioritise their own health during this time. Planning of future interventions would benefit from some in depth, qualitative research with mothers who do not elect to take up postpartum programs. This would enhance understanding of the barriers to women’s engagement in supportive programs to assist their own health following childbirth.

Furthermore, the many barriers to participation in the mums OnLiNE program, highlighted by the findings presented from Study 4 (Chapter 6), as well as previously documented barriers to healthy postpartum behaviours (426), reflect the need for provision of support at a population level to assist women in feeling comfortable, confident and at ease with attending to their own health whilst simultaneously caring for their newborn. Whilst the ideal approaches aimed at achieving this are unknown, this is a vital consideration in assisting women to attain a healthy weight and healthy diet and PA behaviours.

Importantly, the qualitative work presented in Study 4 has provided insight into future opportunities for supporting women in their attainment of healthy weight and healthy dietary and PA habits following childbirth. The recommendations made by this important group of women, including convenient methods of self-monitoring such as the use of smartphone apps, more rigorous group support and possible interaction with Facebook, have helped inform the design of future, similar interventions. Yet, regardless of the strategies utilised in delivering interventions to new mothers, results from the qualitative work with women undertaken in Study 4 showed that they viewed the provision of support in a positive light, that they felt increased motivation as a result of being involved in a postpartum intervention with other first time mothers and that they appreciate the support provided during a period which can be challenging and socially isolating. This indicates that new mothers are a population highly receptive to provision of support and who view delivery of care in a positive light, reinforcing the importance of engaging with women during this unique time.
7.2.3 Other areas for further investigation

This thesis has prompted the potential usefulness of further investigation into some other measures, which differ to the clinical management and intervention strategies discussed above. For example, sedentary behaviour has previously been described as an important determinant of health, independent of PA (515). Whilst findings from Study 3 provided some useful insight into patterns of TV/DVD/video viewing time, future work should build on this and explore postpartum sedentary behaviour in greater detail. More thorough assessment of sedentary behaviour across the perinatal period and its association with GWG and PPWR, independent of PA patterns is especially warranted. Moreover, rather than interventions being focussed on increasing PA during pregnancy or the postpartum period, a focus simply on reducing sedentary time as an attainable goal for new mothers may be a successful approach in encouraging women to be more active during the postpartum period. Monitoring and reducing sedentary time in pregnant and postpartum women is particularly relevant, when existing barriers to exercise such as limited time, fatigue, morning sickness, lack of knowledge and limited childcare options are common (322, 516).

As outlined in Chapter 5 (5.9) programs which promote healthy dietary habits and adequate PA for both the mother and child concurrently might be effective in improving maternal lifestyle behaviours during the postpartum period. Supportive strategies which integrate mother-child activities, such as ‘mums and bubs’ exercise classes present an opportunity to positively impact the health of both the mother and the child. Rather than viewing childbearing as a barrier to women attaining healthy lifestyle behaviours, perhaps this should be considered an opportunity to simultaneously optimise healthy behaviours for two generations. Future work might look beyond enrolling only women to postpartum interventions, aiming to recruit mothers and their newborns together and tailor the intervention to incorporate both the mother and the child’s participation. Whilst no interventions with first time mothers to date have been conducted in this manner, the approach warrants further investigation and could be a suitable way to integrate maternal and child health whilst overcoming existing barriers to new mother’s participation in such programs.

Whilst this thesis has focussed on first time mothers, women who have had non-singleton pregnancies or who have had multiple pregnancies are also likely to be at risk for excess GWG during subsequent pregnancies and PPWR as a result of a previous pregnancy. This sub-group
of mothers should not be overlooked and are an important population for interventions targeting maternal weight. However, the barriers faced by these women are likely to be different to those faced by new mothers. These mothers are caring for more than one child and consequently there may be more difficulty faced with engaging these women. Supportive strategies for and approaches to delivery of weight-loss interventions might differ considerably amongst such populations. Future work should not be confined to weight and healthy lifestyle considerations amongst first time mothers only.

7.3 Strengths & limitations

Qualitative assessment of the views of both clinicians towards GWG and first time mothers regarding a postpartum intervention was a major strength of this thesis. In both cases, information obtained from one-on-one interviews has contributed novel insights. These studies have provided additional depth of understanding regarding clinical management of GWG and evaluation of a postpartum pilot intervention (Study 4). Study 4 has also provided unique and important information and suggestions for the design of future interventions targeting PPWR in first time mothers.

Further, this thesis reported the methodology and results from an original postpartum intervention with first time mothers. The innovative design of the intervention has potential to be implemented practically in a ‘real world’ setting. For example, whilst a cost benefit analysis would need to be undertaken to determine cost effectiveness, the relatively low dose of the intervention and utilisation of a no cost, commercially available website and/or one off low cost payment to download the smartphone app makes this approach appealing in terms of public health utility. Moreover, if Facebook was utilised in future intervention delivery, this would provide a familiar and inexpensive service for women and is already being accessed regularly by many new mothers.

Likewise, the telephone calls to women were relatively low dose and easily implemented. As findings from Study 4 highlight, telephone support was by far the most preferred intervention component and was considered to be the most useful aspect of the mums OnLiNE intervention, reflected by qualitative interviews with participants who completed the intervention. Telephone counselling is not a new approach to delivering weight-loss and healthy lifestyle support in the general population (571) and has been utilised with some promise as part of
supportive strategies aimed at improving mothers’ stress levels during the postpartum period (621). Consequently, it is a technique which could be easily implemented into this population group for the purpose of assisting healthy postpartum weight attainment and healthy lifestyle behaviours. The intervention design therefore holds much promise for the planning and implementation of future, larger intervention studies.

Whilst the intervention was shown to be successful in reducing WC measures and PPWR, it was not sufficiently powered to show clinically meaningful differences in anthropometric measures. Therefore, larger sample sizes would be needed to draw significant conclusions about the results of the intervention. Moreover, a high proportion of women enrolled in the InFANT Extend RCT and the mums OnLiNE program were predominately of mid to high SES, defined by weekly household incomes of $1500-$2000 or more. Most were also highly educated, with over 50% of women having a university or higher university degree and most were Australian born. Therefore, this thesis is limited in terms of its generalisability to wider populations. Exploration of the issues examined in this thesis are equally important in women who are of a lower SEP, are less educated and in culturally diverse populations.

Lastly, it was unknown to what extent the content delivered as part of the InFANT Extend RCT impacted upon the outcomes measured as part of the mums OnLiNE study. Provision of advice included as part of the InFANT Extend intervention might have diluted the intervention effect of the mums OnLiNE program. Yet, the fact that key outcomes were similar between mums OnLiNE control groups (the control group and the intervention group for InFANT Extend) suggests the content delivered as part of InFANT Extend did not influence these outcomes for the women enrolled in mums OnLiNE.

7.4 Conclusion

This thesis has contributed to understanding opportunities to promote healthy maternal weight during pregnancy and following childbirth. Whilst multiple adverse health implications of both excess GWG and PPWR have been well documented, inconsistencies regarding the clinical management of maternal weight across the perinatal period are evident. This thesis has shown that many barriers exist in the provision of adequate support for women to attain a healthy weight, both during pregnancy and following childbirth. New mothers are also faced with
numerous barriers to adopting healthy lifestyles and face difficulty prioritising their own health during the postpartum period.

This thesis has also shown that it is common for new mothers to be heavier during the postpartum period compared to pre pregnancy, and that many women are not meeting healthy diet and/or PA recommendations across the perinatal period. Yet, few women receive healthy weight and lifestyle advice from their antenatal healthcare providers, particularly during the postpartum period. Moreover, with healthcare provider advice being shown not to predict healthy lifestyle behaviours in new mothers, more rigorous approaches to targeting maternal weight, such as lifestyle interventions, are likely to be more successful than provision of advice alone.

Findings from the mums OnLiNE study are consistent with previous findings that have identified that postpartum interventions which include both diet and PA components as part of their intervention, rather than just one of these alone are more likely to be successful in limiting PPWR (250, 251). Furthermore, interventions which employ online and telephone support strategies in their delivery, such as the mums OnLiNE intervention have capacity to assist women in healthy weight attainment during the postpartum period. Weight-focussed programs aimed at promoting group support and interaction, which include simple and convenient self-monitoring components and incorporate motivational counselling, are preferred by first time mothers to assist overcoming the many barriers they face during this time.

In conclusion, this thesis has highlighted the need for better provision of support for healthy maternal weight both during pregnancy and following childbirth. This thesis has progressed understanding of the current management strategies of GWG, PPWR and healthy lifestyle behaviours across the perinatal period, and has identified suitable opportunities to support new mothers in their attainment of healthy weight following childbirth. Lastly, there is a continued need for future investigation into opportunities to promote healthy maternal weight across the perinatal period, in the interest of reducing the risk of maternal obesity and related morbidity.
References


73. Lindsay CA, Huston L, Amini SB, Catalano PM. Longitudinal changes in the relationship between body mass index and percent body fat in pregnancy. Obstetrics & Gynecology. 1997;89(3):377-82.


250. Amorim AR, Linne YM, Lourenco PM. Diet or exercise, or both, for weight reduction in women after childbirth. *Cochrane database of systematic reviews (Online)*. 2007 (3):CD005627.


Sharma M, Romas J. Theoretical Foundations of Health Education and Health Promotion Sudbury, MA: Jones and Bartlett; 2008.

227


Lipsky LM, Strawderman MS, Olson CM. Maternal Weight Change Between 1 and 2 Years Postpartum: The Importance of 1 Year Weight Retention. Obesity. 2012.


National Health and Medical Research Council. Department of Health and Ageing. Dietary Guidelines for Australian Adults Australia National Health and Medical Research Council 2003


Parker JD, Abrams B. Differences in postpartum weight retention between black and white mothers. *Obstetrics And Gynecology*. 1993;81(5 ( Pt 1)):768-74.


Wilkins C. A qualitative study exploring the support needs of first-time mothers on their journey towards intuitive parenting. Midwifery. 2006;22(2):169-80.


Appendices
Appendix 1
Publication: Systematic review of lifestyle interventions to limit postpartum weight retention: implications for future opportunities to prevent maternal overweight and obesity following childbirth
Obesity Prevention

Systematic review of lifestyle interventions to limit postpartum weight retention: implications for future opportunities to prevent maternal overweight and obesity following childbirth

P. van der Pligt1, J. Willcox1, K. D. Hesketh1, K. Ball1, S. Wilkinson2, D. Crawford1 and K. Campbell1

1Centre for Physical Activity and Nutrition Research, School of Exercise and Nutrition Sciences, Deakin University, Burwood, Victoria, Australia; 2Mater Medical Research Institute, South Brisbane, Queensland, Australia

Address for correspondence: Ms Paige van der Pligt, Centre for Physical Activity and Nutrition Research, School of Exercise and Nutrition Sciences, Deakin University, 221 Burwood Highway, Burwood, Vic. 3125, Australia.
E-mail: p.vanderpligt@deakin.edu.au

Summary

Postpartum weight retention can predict future weight gain and long-term obesity. Moreover, failure to lose weight gained during pregnancy can lead to increased body mass index for subsequent pregnancies, increasing the risk of adverse maternal and foetal pregnancy outcomes. This systematic review evaluates the effectiveness of lifestyle interventions aimed at reducing postpartum weight retention. Seven electronic databases were searched for intervention studies and trials enrolling women with singleton pregnancies and published in English from January 1990 to October 2012. Studies were included when postpartum weight was a main outcome and when diet and/or exercise and/or weight monitoring were intervention components. No limitations were placed on age, body mass index or parity. Eleven studies were identified as eligible for inclusion in this review, of which 10 were randomized controlled trials. Seven studies were successful in decreasing postpartum weight retention, six of which included both dietary and physical activity components, incorporated via a range of methods and delivered by a variety of health practitioners. Few studies utilized modern technologies as alternatives to traditional face-to-face support and cost-effectiveness was not assessed in any of the studies. These results suggest that postpartum weight loss is achievable, which may form an important component of obesity prevention in mothers; however, the optimal setting, delivery, intervention length and recruitment approach remains unclear.

Keywords: Intervention, postpartum, weight retention.

Obesity reviews (2013)

Introduction

Increasing rates of adult overweight and obesity appear to be most pronounced in women (1).

Specifically, women aged 25–34 years have a greater risk of substantial weight gain compared with men of all ages (2,3) and compared with older women, those aged 18–36 years are gaining weight most rapidly (4). With approximately half of all women of childbearing age either overweight or obese (5–8), gestational weight gain (GWG) and postpartum weight retention (PPWR) may be highly influential in contributing to noticeable differences in weight gain during the reproductive years (2,9).

Excess GWG has consistently been identified as the strongest predictor of PPWR (10–12), with clear associations having been reported across multiple studies (13–17). Of concern is that the postpartum period is a life stage characterized not only by weight retention, but also by...
susceptibility to excessive weight gain (18), compounding the risk for future obesity and related morbidity across the reproductive cycle. As such, the postpartum period presents as a key public health consideration for delivery of weight-focused interventions in a population particularly vulnerable to excessive weight gain.

For many women the amount of weight retained is variable both early in the postpartum period and beyond the first year following childbirth. It has been estimated that at 6 weeks postpartum two-thirds of women weigh more than they did prior to pregnancy (19,20). In the United States of nearly 4 million women giving birth each year, approximately 25% experience greater than 4.5 kg weight retention at 1 year postpartum (21). Further, between 6 and 18 months postpartum, 15–20% of women are reported to retain more than 5 kg (19,22).

Maternal weight retention has implications for weight-related health of the mother and the offspring in both the short and long term. Increased body mass index (BMI) from one pregnancy to the next is associated with increased risk of multiple, serious obstetric (14,23–31) and neonatal outcomes (32–39), during subsequent pregnancies. For example, results from a large nationwide study of 151,025 Swedish women, with their first two consecutive births between 1992 and 2001 (40), showed that compared with women whose BMI changed between -1.0 and 0.9 units, risk of adverse pregnancy outcomes for women who gained three or more units, during the average 2-year period, were much higher (40). The authors of that study suggested that even modest increases in BMI before subsequent pregnancies could result in perinatal complications, even if a woman does not become overweight during that time (40).

Further, at the end of the first year postpartum, weight retention has been found to predict maternal overweight 15 years later (41) and could contribute to the development of obesity and associated conditions including heart disease and diabetes (42–44). Importantly, weight retention as a result of pregnancy may be particularly harmful (18) as it tends to be centrally rather than peripherally deposited (18,45–47), increasing risk for development of cardiovascular disease (18,47,48).

The postpartum period is a time when many women want to lose weight (49–50). However face-to-face practitioner and patient contact occurs on less occasions during the postpartum period, compared with during pregnancy, when frequent antenatal appointments are a focus of routine practice. The absence of regular maternal-focused postnatal consultations reduces the opportunity for clinicians to adequately address weight retention through appropriately delivered weight management. Ferrari et al. recently assessed clinician advice on postpartum weight loss and physical activity in 688 women at 3 months postpartum (51). Results showed that the majority (89%) of women reported receiving no weight loss nor physical activity advice (77%) during the postpartum period (51). In a separate study of 179 women, at 4 months postpartum, half (53%) of normal weight women, 79% of overweight women and 81% of obese women reported plans to seek weight loss information, despite 85% of the women overall having received no weight loss information from healthcare providers (52). Therefore, the postpartum period might be considered a missed opportunity for clinically guided weight management. As a result, interventions aimed at supporting women in their attainment of a healthy weight status following childbirth are a key health priority. Supportive interventions could have potential in promoting positive weight outcomes for subsequent pregnancies and long-term health.

Few insights have been offered into best supportive strategies for women in their attainment of healthy postpartum weight through the review of weight-focused interventions to date.

Given this, a systematic review of the literature was conducted to identify and assess the effectiveness of intervention studies aimed at limiting PPWR and promoting healthy maternal weight status following childbirth. This is the first systematic review of its kind focused specifically on PPWR across all maternal BMI groups and builds on earlier published reviews (23,53) and one Cochrane review (54) by presenting an up-to-date analyses of current intervention studies with recommendations for delivering appropriate support to women during this important life stage.

Methods and procedures

The systematic review adhered to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) statement for reporting systematic reviews of studies evaluating healthcare interventions (55).

Study criteria

Intervention studies were reviewed aimed at limiting PPWR and promoting healthy maternal weight in the postpartum period. Studies were included when postpartum weight, weight loss or weight retention was the main outcome and when dietary and/or exercise and/or weight monitoring were included as a component of the intervention. Studies that enrolled women with non-singleton pregnancies and that were not specifically designed to promote healthy weight attainment following childbirth were excluded. Interventions that commenced during pregnancy were also excluded except for when the study explicitly compared effects between a group recruited during pregnancy with a group recruited in the postpartum period. This allowed for PPWR to be assessed independently, which was consistent with our study aims. There were no limitations placed on length of intervention, age, BMI or parity.
Search strategy

A comprehensive search of the literature was conducted using EMBASE, MEDLINE, Academic Search Complete, CINAHL with full text, Health Policy Reference Center, Health Source: Nursing/Academic Edition and PsycINFO. Searches were carried out in August 2012 and October 2012 and were limited by year (1990–2012), covering both the introduction of Institute of Medicine (IOM) guidelines for GWG in 1990 and refinement of the guidelines in 2009, thus allowing a definition for excess GWG (weight gain above IOM recommendations for weight gain during pregnancy) – the strongest single predictor of PPWR (10–12).

The search strategy combined the keywords intervention* OR trial* OR RCT OR ‘randomized controlled trial’* OR strategy* OR program* OR method* OR education with each of postpartum OR ‘post partum’ OR postnatal OR ‘post natal’ OR ‘post pregnancy’ OR ‘post childbirth’ OR ‘following pregnancy’ OR ‘following childbirth’ with each of ‘weight retention’ OR ‘weight loss’ OR BMI OR ‘body mass index’ OR overweight OR obes* OR dietary OR diet OR nutrition OR ‘healthy eating’ OR ‘physical* activ*’ OR exercis*. (NOT terms included ‘during pregnancy’ OR pregnancy OR gestational). Studies were limited to English only, peer-reviewed journals and human studies published between 1990 and 2012 across all databases, with additional limits applied independently for multiple database searches.

Data extraction

A data extraction template adapted from published systematic reviews conducted previously by two of the authors (56,57) guided data extraction. Two researchers (Pv and JW) independently extracted the data addressing study methodology, participant characteristics, intervention design and study outcomes. Differences in data extraction and interpretation were resolved through discussion.

Quality assessment

Studies were assessed for quality according to the McMaster University quality assessment tool (58). The six-component rating scale was used to evaluate selection bias, study design, confounders, blinding, data collection methods, and withdrawals and dropouts. A rating of weak, moderate or strong is allocated to each of the six components, based on a specific criteria. Where detail of a component is not described, a rating of weak is given, except for blinding where a moderate rating is given if blinding is not described. An overall study rating is derived of weak (two or more weak ratings from the six components), moderate (less than four strong ratings and one weak rating) or strong (four strong ratings with no weak ratings).

Two authors (Pv and JW) independently assessed study quality, and any discrepancies in component ratings were resolved through discussion.

Results

Study selection

The EBSCO host platform search including Academic Search Complete, CINAHL with full text, Health Source: Nursing/Academic Edition, Health Policy Reference Center and PsycINFO retrieved 455 papers. The title and abstract of each paper were then reviewed by Pv to determine eligibility and where insufficient information was available in the title or abstract, full papers were retrieved and assessed for inclusion. This resulted in 13 papers being retained and fully assessed. Of these, five papers met the inclusion criteria. The bibliographies of all full-text papers were hand searched for possible identification of additional eligible studies. One paper was included through this process. The separate search using the Elsevier platform including EMBASE and MEDLINE retrieved 6,988 papers. After reviewing the title and abstract of each paper, eight studies were selected and were fully reviewed. Of these, five papers met the inclusion criteria. As mentioned earlier, the bibliographies of all full-text papers were hand searched. No additional papers were included. Papers were excluded across all searches if they were not an intervention study, if PPWR or maternal weight loss were not part of the main focus of the intervention and if weight was not reported as a key study outcome. Any discrepancy about study eligibility or inclusion was resolved through discussion. Eleven studies in total were identified as eligible for inclusion in this systematic review (see Fig. 1). A summary of the included studies is presented in Table 1. Of the 11 intervention studies included in this review, seven were successful in reducing PPWR and promoting weight loss (59–65).

Study design

One study included in this review was a non-randomized controlled trial (RCT) (66) whereas all other studies were RCTs (59–65,67–69), three of which were three-arm RCTs (61,62,64) and one study a four-arm RCT (59). Six studies were conducted in the United States (60,63–65,67,69) and one in each of Sweden (59), Finland (66), Canada (61), Taiwan (62) and Greece (68). The length of intervention ranged from 11 d (64) to 9 months (65,67) and 12 months for the women recruited during pregnancy as part of the study conducted by Huang et al. (62).

Participants

Mean age of women across all studies ranged from 28.3 ± 4.4 years (66) to 35.1 ± 4.6 years (61). The
number of women recruited ranged from 31 (60) to 450 (67), and participant retention ranged from 100% at 11 d (64) to 53% at 1 year (65). Four of the 11 studies provided participant response rates that ranged from 43% (69) (n = 38) to 81% (66) (n = 92). Of the seven studies that were successful in limiting PPWR, five of these recruited overweight and obese women only (59–61,65,67) and four were successful in promoting postpartum weight loss (59–61,67). The stage at which participants were recruited during the postpartum period ranged from immediately following birth (24–48h) (62) to 3–12 months postpartum (63). No clear pattern was evident with stage of intervention commencement during the postpartum period and intervention success. Six of the 11 studies recruited women within a given range of either weeks (59,61,64,68,69) or months (63) following birth, and one study recruited women from 6 weeks to 6 months postpartum (65). Three studies specified recruitment exclusively at either 4 weeks (60), 6 weeks (67) or 2 months (66) postpartum. Huang et al. (62) compared two intervention groups, one recruited at 16 weeks gestation and one between 24 and 48 h postlabour (62). Weight loss was successful in the group recruited during pregnancy but not in the group recruited following childbirth (62).

Intervention components

Six of the seven studies that were successful in promoting postpartum weight loss included both dietary and physical activity components (60–65). In addition, the study by Bertz et al. was successful in promoting weight loss in the dietary intervention group only (59), compared with the physical activity intervention group and the combined diet and physical activity group (59). That study was unique in providing women with scales for self-monitoring of weight throughout the intervention period (59). Women allocated to the dietary group were instructed to weigh themselves at home three times per week and were contacted via mobile phone text message biweekly to report their body weight. This was also the only study to use text messaging as an adjunct to individual counselling as part of the intervention. Leermakers et al. used telephone support as part of their intervention (63) and Colleran et al. used email support combined with an online dietary programme (MyPyramid) (60). Both interventions were successful in achieving postpartum weight loss. Østbye et al. included telephone counselling every 6 weeks as part of their 9-month intervention; however, there was no significant difference in weight loss between the intervention and control groups (67).

The study by Zourladani et al. was the only study not to include individual counselling and/or individually tailored diet and/or physical activity support as part of their intervention (68). Their 12-week intervention consisted of supervised, group-based exercise sessions and was not successful in reducing PPWR. Likewise Dewey et al. included only a physical activity component as part of their study (69). Their intervention consisted of supervised and individually tailored exercise sessions. Weight loss and change in percentage body fat between the intervention group and the control group were not shown to be significantly different at 12 weeks.
Table 1: Description of included studies

<table>
<thead>
<tr>
<th>Study</th>
<th>Design</th>
<th>n</th>
<th>Recruitment Sample</th>
<th>Intervention</th>
<th>Outcomes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bertz et al. (59) Sweden 2012</td>
<td>Four-arm RCT</td>
<td>Recruited: n = 68</td>
<td>10-14 weeks postpartum</td>
<td>Age: mean 33.3 years, BMI: mean 30.1 kg m⁻². Demographics: 66% educated &gt;3 years beyond high school, 87% married. Exclusion criteria: pre-pregnancy BMI &lt;25 kg m⁻² or &gt;35 kg m⁻², smoking, multiple birth pregnancies, no intention to breastfeed for 6 months, birth weight of infant &lt;2.5 kg, &gt;20% of infant energy intake as complementary food, presence of maternal or infant illness. Focus: effect of 12-week behaviour modification intervention targeting diet, exercise or combined diet and exercise on weight loss following treatment and at 1 year (9 months post-intervention completion) in overweight and obese women. (C) (n = 13) usual care. (ID) (n = 13) two times individual counselling sessions by dietitian, one at clinic and one at home (2.5 h total). Individual dietary modification plan for 500 kcal d⁻¹ reduction and recommendation for 0.5 kg weekly weight loss. Provision of written material and scales for weight self-monitoring. Biweekly text messages throughout study period. (IPA) (n = 15) two times individual counselling sessions by a physical therapist, one at clinic and one at home (2.5 h total). Recommended 45-min walk, 4 d week⁻¹ at 60-70% max heart rate. Therapist joined woman for walk in both counselling sessions. Provision of written material, heart rate monitor and exercise diary for self-monitoring. Biweekly text messages throughout study period. (IDPA) (n = 16) received diet and exercise conditions concurrently (6 h total counselling). Anthropometry: mean BW and BMI decreased significantly for ID group only over intervention period (-8.3 ± 4.2 kg) (P &lt; 0.001) and at 1 year (-10.2 ± 5.7 kg) (P &lt; 0.001). PA: no significant change in steps per day in any group. Mean daily energy expenditure increased significantly for ID group only over intervention period (108 ± 265 kcal d⁻¹) (P = 0.015), but not post-intervention. Diet mean daily energy intake decreased significantly for ID group only over intervention period (-594 ± 388 kcal d⁻¹) (P &lt; 0.001), but at 1 year had decreased significantly for only the IPA group (-470 ± 542 kcal d⁻¹) (P = 0.023).</td>
<td>Anthropometry: mean BW and BMI decreased significantly for ID group only over intervention period (-8.3 ± 4.2 kg) (P &lt; 0.001) and at 1 year (-10.2 ± 5.7 kg) (P &lt; 0.001). PA: no significant change in steps per day in any group. Mean daily energy expenditure increased significantly for ID group only over intervention period (108 ± 265 kcal d⁻¹) (P = 0.015), but not post-intervention. Diet mean daily energy intake decreased significantly for ID group only over intervention period (-594 ± 388 kcal d⁻¹) (P &lt; 0.001), but at 1 year had decreased significantly for only the IPA group (-470 ± 542 kcal d⁻¹) (P = 0.023).</td>
</tr>
<tr>
<td>Colleran et al. (60) USA 2012</td>
<td>RCT</td>
<td>Recruited: n = 31</td>
<td>4 weeks postpartum</td>
<td>Age: mean 31.1 years, BMI: mean 28.9 kg m⁻². Demographics: 85%, 96% college educated, all with computer access. Exclusion criteria: mothers &lt;23 years and &gt;37 years, non-full-term (&gt;37 weeks) infants, infants &gt;3 weeks old, BMI &lt;25 kg m⁻² or &gt;30 kg m⁻², not fully breastfeeding, ≥3 d week⁻¹ structured exercise for past 3 months, smoking in past 6 months, caesarean delivery, presence of a medical condition affecting hormone levels. Focus: effect of 16-week PP counselling, exercise and online resource intervention on diet and weight loss in overweight and obese women. (C) (n = 12) asked not to participate in structured exercise and received two standard diet and nutrition public health written handouts. (IDPA) (n = 14): weekly 15-min dietary counselling by dietitian at participant’s home. Calorie restriction by 500 kcal d⁻¹. Up to two additional weekly home visits by dietitian to help facilitate exercise programme. Exercise protocol involved strength training three times per week, walking 10,000 steps or 3,000 aerobic steps per day ≥5 d week⁻¹. Online access to MyPyramid Menu Planner for Moms to assist dietary intake to recommendations. Participants asked to log ≥3 d week⁻¹ dietary intake to facilitate weight loss and nutrition intake towards recommendations. Email support provided as needed. Women in IDPA and C groups received multivitamin supplement without minerals and contacted biweekly to assess physical activity, use of dietary supplements and infant feeding.</td>
<td>Anthropometry: mean BW significantly decreased for IDPA group (-5.8 ± 3.5 kg) (7%) compared with the C (-1.6 ± 5.4 kg) (3%) (P = 0.03). PA: results not reported. Diet energy intake decreased significantly for both groups but total reductions were significantly more for the IDPA group (-613 ± 521 kcal d⁻¹) compared with the C group (-171 ± 456 kcal d⁻¹) (P = 0.03).</td>
</tr>
</tbody>
</table>
Table 1 Continued

<table>
<thead>
<tr>
<th>Study</th>
<th>Design</th>
<th>n</th>
<th>Recruitment</th>
<th>Sample</th>
<th>Intervention</th>
<th>Outcomes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Davenport et al. (61) Canada 2011</td>
<td>Three-arm RCT</td>
<td>Recruited: n = 67 RR, not reported Retention: n = 60 (90%)</td>
<td>7-9 weeks postpartum</td>
<td>Age: mean 33.4 years, BMI: mean 27.0 kg m⁻², Demographics: 87% Caucasian, 86% breastfeeding, parity 1.6 ± 0.8-2.0 ± 1.1, all women had increased risk factors for development of chronic disease at baseline.</td>
<td>Focus: effect of 16-week PP nutrition and low- vs. moderate-intensity exercise intervention on chronic disease risk factors. (C) (n = 20) sedentary (exercised ≤ once per week assessed by questionnaire at 2 and 6 months PP), received literature summarizing the Canadian Food Guide - Canada’s Guide to Physical Activity and Eat Well. (IPA) (low intensity) (n = 20) supervised walking for 45 min at 30% HRR, three to four times per week. (IPA) (moderate intensity) (n = 20) supervised walking for 45 min at 70% HRR, three to four times per week. Both IPA groups given pedometer to monitor daily step counts and received individualized nutrition plan at baseline from dietitian.</td>
<td>Anthropometry: significantly greater PP weight loss for low (~2.2 ± 4.0 kg) and moderate (~5.0 ± 2.9 kg) intensity groups compared with C group (0.1 ± 3.3 kg) (P &lt; 0.01). Reductions in body mass not significantly different between low (5.6%) and moderate (7.0%) intensity groups. Waist circumference significantly improved in both intervention groups (P value not reported). PA daily step counts not significantly different between intervention groups (0.001). 7.344 ± 2.638 steps; 70%, 7.492 ± 2.281 steps (P = 0.62). Not measured for C group. Diet intake not significantly different between three groups at 2 or 6 months PP.</td>
</tr>
<tr>
<td>Dewey et al. (69) USA 1994</td>
<td>RCT</td>
<td>Recruited: n = 38 RR, 43% Retention: n = 33 (87%)</td>
<td>6-8 weeks postpartum</td>
<td>Age: mean 30.4 years, BMI: not reported, mean BW: 67.2 kg, Demographics: mean years education 16.5 years, mean parity 1.8, 86% Caucasian.</td>
<td>Focus: effect of 12-week exercise intervention during lactation on outcomes related to energy expenditure including PP weight loss and lactation. (C) (n = 15) exercised ≤ once per week as assessed by standardized questionnaires (IPA) (n = 18) individually tailored walking, jogging or cycling sessions, five times per week, 45 min each at 60–70% HR max.</td>
<td>Anthropometry: No significant difference between IPA and C in weight loss or change in % body fat (P values not reported). PA no significant difference in mean energy expenditure (kcal d⁻¹) between IPA (2,002 ± 365 kcal d⁻¹) and C (2,054 ± 349 kcal d⁻¹) groups. Diet intake not significantly different between intervention groups (2,168 ± 328 kcal d⁻¹) compared with IPA group (2,497 ± 436 kcal d⁻¹) (P &lt; 0.05).</td>
</tr>
<tr>
<td>Huang et al. (62) Taiwan 2011</td>
<td>3 arm RCT</td>
<td>Recruited: n = 240 RR, not reported Retention: n = 189 (79%)</td>
<td>16 weeks gestation and 24-48 h post birth</td>
<td>Age: mean 31.6 years, BMI: range 16.6–36.9 kg m⁻², Demographics: 45% primiparous, 41% employed, 82% college educated.</td>
<td>Focus: effect of 6- and 12-month individual PA and diet counselling on PPWR. (C) (n = 64) routine outpatient department obstetric education and face-to-face discussion with nurse educators once per trimester, written material addressing health and exercise during pregnancy. (IDPA) (1) from pregnancy to 6 months postpartum delivered by nurse. Both IDPA groups received written material for weight recommendations, PA and nutrition and individual GWG and PPWR targets with additional session for women exceeding weight recommendations.</td>
<td>Anthropometry: PPWR at 6 months significantly less for the IDPA (1) group (2.34 ± 2.7 kg) compared with the IDPA (2) group (4.08 ± 3.6 kg) and the C group (5.08 ± 3.3 kg) (P &lt; 0.001). PPWR ≥5 kg at 6 months significantly less for the IDPA (1) group (15%) compared with the IDPA (2) group (42.2%) and the C group (51.6%) (P = 0.000). PA and nutrition lifestyle behaviour scores higher for women receiving either intervention at 6 months PP compared with C group.</td>
</tr>
</tbody>
</table>

**Notes:** Adjustments for BMI at baseline, age at baseline, and education. 6-12 months of follow-up. P value not reported (IPA) (1).
## Table 1 Continued

<table>
<thead>
<tr>
<th>Study</th>
<th>Design</th>
<th>n</th>
<th>Recruitment</th>
<th>Sample</th>
<th>Intervention</th>
<th>Outcomes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kinnunen et al. (66)</td>
<td>non-RCT</td>
<td>Recruited: n = 92</td>
<td>2 months postpartum</td>
<td>Age mean 28.9 years. BMI: mean 28.0 kg m&lt;sup&gt;-2&lt;/sup&gt;. Demographics: 47% basic or secondary educated, 63% non-smoking pre- and post-pregnancy. Exclusion criteria: multiparous women, &lt;18 years, type 1 or type 2 diabetes mellitus, twin pregnancy, physical disability preventing exercise participation, substance abuse, psychiatric illness, inadequacy in Finnish language, intention for change of residency within 3 months.</td>
<td>Focus: effect of 8-month individual diet and PA counselling on diet, PA and weight loss to pre-pregnancy BW in primiparous women (C) (n = 37). usual diet and PA counselling delivered by public health nurses at the three control clinics. (IDPA) (n = 48): five routine visits to an intervention clinic where public health nurses delivered extended weight, PA and diet counselling. Weight loss encouraged if PP weight was higher than pre-pregnancy BW, addition of individual PA plans, PA written material and option of attending supervised group exercise class once per week for 45-60 min. Advice on healthy meal patterns, increased fruit and vegetable intake, increased fibre and decreased high sugar foods included in dietary counselling. Women asked to keep weekly food records.</td>
<td>Anthropometry: No significant difference in PPIAR, WC or proportion of weight loss in the IDPA (50%) and C (30%) returning to pre-pregnancy BW at 10 months PP. But IDPA group had significantly higher adjusted OR for returning to pre-pregnancy BW than C group 3.89 (95% CI (1.16-13.04). PA: no significant changes in leisure time physical activity between groups. Diet: no dietary differences except greater proportion of high-fibre bread consumed for IDPA group compared with control group (P = 0.008).</td>
</tr>
<tr>
<td>Leemarkers et al. (63)</td>
<td>RCT</td>
<td>Recruited: n = 90</td>
<td>3–12 months postpartum</td>
<td>Age mean 31.4 years. BMI: mean 28.9 kg m&lt;sup&gt;-2&lt;/sup&gt;. Demographics: mean PPWR 12.3 kg, 97% Caucasian, 86% married, mean 8 months PP. Exclusion criteria: &lt;18 years, delivery not within past 3–12 months, weight retention &lt;6.8 kg compared with pre-pregnancy weight, BMI &lt;22 kg m&lt;sup&gt;-2&lt;/sup&gt;, women currently lactating.</td>
<td>Focus: effect of 6 months correspondence behavioural weight control programme on weight loss to pre-pregnancy BW. (C) (n = 36). received written information about healthy eating and PA. (IDPA) (n = 36): group sessions at baseline and 2 months, 16 written lessons via mail weekly for first 12 weeks, bimonthly for next 4 weeks and monthly for last 8 weeks and short (5–15 min) telephone calls weekly or bimonthly from research staff. Dietary advice included calorie restriction PA prescription with emphasis on self-monitoring.</td>
<td>Anthropometry: significantly greater weight loss for IDPA (7.8 ± 4.5 kg) compared with C group (4.9 ± 5.4 kg) (P &lt; 0.03) and greater percentage loss of pre-treatment BW 10.0 ± 5.8% vs. 5.8 ± 5.7% (P &lt; 0.006). 79% of IDPA group and 44% of C group lost excess PP weight (P = 0.01) and 33% of IDPA group and 11.5% of C group returned to prepregnancy weight (P &lt; 0.005). PA: no change in energy expenditure for either group. Diet: IDPA group and C group both significantly reduced percentage energy from fat (-6.2% and -6.4%, respectively) (P &lt; 0.001) but differences not significant between groups.</td>
</tr>
<tr>
<td>McCror y et al. (64)</td>
<td>Three-arm RCT</td>
<td>Recruited: n = 67</td>
<td>8–16 weeks postpartum</td>
<td>Age mean 31.5 years. BMI: mean 25.2 kg m&lt;sup&gt;-2&lt;/sup&gt;. Demographics: multiparous (63%), Caucasian (79%). Exclusion criteria: &lt;18 years or &gt; 16 weeks postpartum, non-breastfeeding, smoking, presence of a chronic disease or taking regular medication, not willing to exercise 3 d week&lt;sup&gt;-1&lt;/sup&gt; for ≥1 month pre-intervention.</td>
<td>Focus: effect of an 11 d dietary restriction intervention and a dietary restriction plus exercise intervention on lactation performance and maternal weight loss in breastfeeding women. Control condition (n = 29): women asked to maintain weight and usual diet and PA patterns. (ID) (n = 23): individual diet prescription including provision of preweighed food for 36% energy deficit. Protein allowance for lactation 15 g d&lt;sup&gt;-1&lt;/sup&gt; above that for non-lactating women. Provision of a multivitamin. No additional exercise prescribed. (IDPA) (n = 22): diet condition described above plus additional daily exercise comprising self-supervised aerobic sessions at 50–70% HR max for prescribed time to promote target energy deficit. Subjects chose their own activities.</td>
<td>Anthropometry: both intervention groups had significantly greater weight loss than C group (-0.2 ± 0.6 kg) (P &lt; 0.0001). No significant difference in weight loss between the ID (-1.9 ± 0.7) and IDPA groups (-1.6 ± 0.5). PA: mean exercise sessions 4 week&lt;sup&gt;-1&lt;/sup&gt; and 499 ± 87 min week&lt;sup&gt;-1&lt;/sup&gt; significantly greater than ID group (2.8 ± 0.8 d week&lt;sup&gt;-1&lt;/sup&gt; and 126 ± 86 min week&lt;sup&gt;-1&lt;/sup&gt;) and the C (2.8 ± 0.8 d week&lt;sup&gt;-1&lt;/sup&gt; and 136 ± 126 min week&lt;sup&gt;-1&lt;/sup&gt;) (P &lt; 0.001). Diet: mean energy intake and % energy from fat, carbohydrate, protein not significantly different between groups and no significant change from baseline in either intervention group.</td>
</tr>
</tbody>
</table>
Anthropometry: no significant difference in mean weight loss between the IDPA (0.90 ± 5.1 kg) and C groups (0.96 ± 4.9 kg), nor for return to pre-pregnancy BW, % weight loss, change in BMI category and proportion losing ≥5 or 1.0 kg. PR: no significant differences. Diet: no significant differences.

### Table 1 Continued

<table>
<thead>
<tr>
<th>Study</th>
<th>Design</th>
<th>n</th>
<th>Recruitment</th>
<th>Sample</th>
<th>Intervention</th>
<th>Outcomes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Østbye et al. (67)</td>
<td>RCT</td>
<td>Recruited: n = 450</td>
<td>6 weeks postpartum</td>
<td>Age mean 30.9 years. BMI: 25.9 ± 5.1 kg m⁻² (40%), 30–34.9 kg m⁻² (31%), 25–29.9 kg m⁻² (16%), 40+ kg m⁻² (13%)</td>
<td>Focus: effect of 9-month multicomponent diet and PA intervention on BMI reduction in overweight and obese women. (IDPA) (n = 207)</td>
<td>Anthropometry: no significant difference in mean weight loss between the IDPA (0.90 ± 5.1 kg) and C groups (0.96 ± 4.9 kg), nor for return to pre-pregnancy BW, % weight loss, change in BMI category and proportion losing ≥5 or 1.0 kg. PR: no significant differences. Diet: no significant differences.</td>
</tr>
<tr>
<td>USA 2003</td>
<td></td>
<td>Retention n = 225</td>
<td></td>
<td>Demographics: 69% married, 53% Caucasian, 55% college educated or above, 41% primate, 42% household income &lt;60,000. Exclusion criteria: pre-pregnancy BMI &lt;25 kg m⁻², non-English speaking, &lt;18 years, presence of a health condition preventing ability to walk one mile unassisted.</td>
<td>RR (n = 207) biweekly newsletters with general tips relative to postpartum motherhood. (IDPA) (n = 225) eight healthy-eating classes with recommendations for calorie restriction, 10 physical activity group sessions specifically designed for mothers and six individual telephone counselling sessions every 6 weeks for 20 min each delivered by a trained counsellor. Women received written PA information, recipes, pedometer and sports stroller to encourage walking outside group classes.</td>
<td></td>
</tr>
<tr>
<td>O’Toole et al. (68)</td>
<td>RCT</td>
<td>Recruited: n = 40</td>
<td>6 weeks–6 months postpartum</td>
<td>Age mean 31.5 years. BMI: 29.9 ± 4.2 kg m⁻²</td>
<td>Focus: effect of structured diet and PA intervention for overweight women on weight loss at 12 weeks and at 1 year PP. (C) (n = 20) met with dietitian and exercise physiologist for 1 h educational session and given written diet and PA written material. Recommended to reduce dietary intake by 350 kcal d⁻¹.</td>
<td>Anthropometry: Mean PP weight loss significant for IDPA group by 12 weeks (~6.2 ± 2.2 kg) and 1 year (7.3 ± 2.2 kg) from baseline (P &lt; 0.001). Mean BW significantly less for IDPA group at 12 weeks (73.0 ± 2.2 kg) compared with C (84.1 ± 2.3 kg) (P &lt; 0.05) and at 1 year PP (71.3 ± 2.2 kg and 84.1 ± 4.3 kg, respectively) (P &lt; 0.05). Mean % body fat was significantly less in the IDPA (36 ± 1.8) compared with C group (44.1 ± 2.3%) (&gt;0.05) at 12 weeks and 1 year (35.3 ± 1.9) (44.3 ± 2.3) (P &lt; 0.05) due to significant declines observed in the IDPA group over the course of study. PA: vigorous intensity exercise was significantly higher than the C group at 12 weeks (18.0 ± 2.7 kcal week⁻¹) (P &lt; 0.05) and 1 year PP (15.0 ± 4.2 kcal week⁻¹) (P &lt; 0.05). No significant differences in cardiovascular measures. Diet: no significant between group differences in caloric intakes at any time; intakes significantly decreased in both groups.</td>
</tr>
<tr>
<td>Greece 2003</td>
<td></td>
<td>Retention n = 17</td>
<td></td>
<td>Demographics: predominantly Caucasian (one subject African–American), 75% college graduates, &gt;15 kg GWG and &gt;5 kg PPWR, mean 14 ± 4 weeks and 12 ± 5 weeks PP at enrolment. Exclusion criteria: BMI &lt;25 kg m⁻², current participation in an alternate exercise programme or formal weight loss programme, presence of a medical condition contraindicating PA or diet intervention.</td>
<td>Focus: effect of 12-week low-intensity exercise intervention on psychosocial well-being and physical well-being including maternal weight loss in PP women. (C) (n = 20) no intervention. (IPPA) (n = 20) group-based, low impact exercise programme for 3 d week⁻¹ lasting 50–60 min each. Designed in accordance with the ACE guidelines and delivered by certified instructor. Sessions included a combination of low impact aerobic, stretching, muscle strengthening and relaxation/yoga. Sessions were supervised and exercise intensity individually tailored to 75% HR max.</td>
<td>Anthropometry: no significant difference in weight from baseline (65.7 ± 10.8 kg) to 12 weeks (64.4 ± 10.7 kg) for the C group or for the IPA group (65.1 ± 9.6 kg) to 61.8 ± 10.0 kg. No significant between group differences. PR: not reported. Diet: not reported.</td>
</tr>
</tbody>
</table>

© 2013 The Authors. *Systematic reviews © 2013 International Association for the Study of Obesity*
Theoretical frameworks
Two of the 11 interventions were underpinned by theoretical frameworks. Kinnunen et al. (66) based the physical activity component of their intervention on PRECEDE-PROCEED, and stages of change and the intervention conducted by Østbye et al. (67) was underpinned by social cognitive theory, stages readiness and motivational models. Neither intervention was successful in showing differences in PPWR between control and intervention groups.

Intervention delivery
Intervention delivery was undertaken by a range of health professionals across studies. Nurses delivered the intervention in two studies (62,66), one of which was successful in promoting postpartum weight loss (62). Other studies that showed no significant difference in postpartum weight loss between the intervention and control groups were delivered by a certified fitness instructor (68), a trained counsellor (67) and a study assistant (69). Dietitian-delivered nutrition counselling was provided in four studies, all of which were successful in promoting postpartum weight loss (59–61,65). One additional study that showed significant differences in weight loss between intervention and control groups was delivered by mailed correspondence and by general programme staff via telephone (63). McCrory et al. (64) did not describe the intervention delivery in their study.

Intervention setting
Interventions that were successful in promoting postpartum weight loss were delivered across a range of settings. Two studies were interventions primarily received in the home (60,64), while three studies were clinic based (59,62,65) and two studies were combined home and clinic based (61,63). The remaining four studies that were not successful in promoting postpartum weight loss were based in a clinic or laboratory (66,68,69) and combined home and clinic based (67).

Additional anthropometric outcomes
Three studies included waist circumference as an anthropometric outcome (61,64,66). Results were not reported in the study by McCrory et al. (64). In the study by Davenport et al., in addition to promoting postpartum weight loss for overweight or obese women recruited to both the low- and moderate-intensity exercise groups (61), waist circumference measures improved significantly for both groups from baseline to 16 weeks (P value not reported) (61). There was no significant change in waist circumference between the control and the intervention groups following an 8-month intervention conducted by Kinnunen et al. nor was their intervention successful in limiting PPWR (66). Both studies included dietary and physical activity components as part of their intervention.

Study quality
A summary of overall methodological quality of included studies is presented in Table 2. Using the McMaster University School of Nursing Quality Assessment Tool for Quantitative Studies (58) one study was rated as strong overall (61), while all remaining studies were rated as being of moderate quality despite variations in individual quality criteria. All studies were rated as strong for study design; however, of the 10 RCTs (59–65,67–69), only seven described the method of randomization of women (59,61,62,64,65,67,68). Four studies reported participant response rates (64,66,67,69) and these varied from 43% (69) to 81 (66). Prior to the intervention, there were differences between control and intervention groups described in one study (63) although a high number (80–100%) of relevant confounders were controlled for in that study. Baseline differences in the study sample were not described in just one of the 11 studies (67). Data collection tools were shown to be both valid and reliable in nine (59,61,62,64,65,67,68). Four studies reported participant response rates (64,66,67,69) and these varied from 43% (69) to 81 (66). Prior to the intervention, there were differences between control and intervention groups described in one study (63) although a high number (80–100%) of relevant confounders were controlled for in that study. Baseline differences in the study sample were not described in just one of the 11 studies (67). Data collection tools were shown to be both valid and reliable in nine (59,61,62,64,65,67,68) of the studies. None of the studies described blinding of study assessments.

Discussion
This systematic review presents a summary of lifestyle interventions aimed at decreasing maternal PPWR, showing that while this outcome is possible, many uncertainties remain as to the most effective approach in supporting women to lose weight during this life stage. The unique period following childbirth has been described as an ideal stage in which to engage with women in promoting healthy weight attainment (52) and is an important time for altering long-term obesity risk for mothers experiencing PPWR. However, studies targeting healthy maternal weight during the postpartum have been varied in their intervention setting, delivery method and intervention components, recruitment time and assessment of anthropometric outcomes.

Undoubtedly, one challenge in determining an optimal approach to provision of support for women during the postpartum period lies with at what point following childbirth interventions should be initiated. There was a noticeable difference in the recruitment stage and commencement of interventions across studies reviewed, varying from between 24 and 48 h following labour, up to 12 months postpartum and varied results in intervention success were apparent. The ideal point at which to commence interventions targeting weight retention therefore

© 2013 The Authors
obesity reviews © 2013 International Association for the Study of Obesity
<table>
<thead>
<tr>
<th>Study</th>
<th>Selection bias</th>
<th>Study design</th>
<th>Confounders</th>
<th>Blinding</th>
<th>Data collection methods</th>
<th>Withdrawals and dropouts</th>
<th>Overall global rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bertz et al. (59) Sweden 2012</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>Moderate</td>
</tr>
<tr>
<td>Colleran et al. (60) USA 2012</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>3</td>
<td>Moderate</td>
</tr>
<tr>
<td>Davenport et al. (61) Canada 2011</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>Strong</td>
</tr>
<tr>
<td>Dewey et al. (69) USA 1994</td>
<td>1</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>Moderate</td>
</tr>
<tr>
<td>Huang et al. (62). Taiwan 2011</td>
<td>1</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>2</td>
<td>Moderate</td>
</tr>
<tr>
<td>Kinnunen et al. (66) Finland 2007</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>3</td>
<td>Moderate</td>
</tr>
<tr>
<td>Leermarkers et al. (63) USA 1998</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>2</td>
<td>Moderate</td>
</tr>
<tr>
<td>McCrory et al. (64) USA 1999</td>
<td>1</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>Moderate</td>
</tr>
<tr>
<td>Østbye et al. (67) USA 2009</td>
<td>2</td>
<td>3</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>2</td>
<td>Moderate</td>
</tr>
<tr>
<td>O'Toole et al. (65) USA 2003</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>1</td>
<td>Moderate</td>
</tr>
<tr>
<td>Zourladani et al. (68) Greece 2011</td>
<td>1</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>Moderate</td>
</tr>
</tbody>
</table>

*Source: McMaster University School of Nursing Quality Assessment Tool for Quantitative Studies (58). 1, weak; 2, moderate; 3, strong for study quality.*
remains uncertain. There was also a distinct absence of rationale for commencing the intervention at the different stages across studies, therefore highlighting a need for further investigation into when it may be best to intervene. Future work addressing timing of intervention delivery might seek to assess the views and perceptions of women themselves to help gain additional insight into this important consideration.

Previous assessment of interventions in the postpartum period recommended that combined diet and physical activity programmes are integral in achieving effective outcomes for the attainment of healthy maternal postpartum weight (54). The present updated review has likewise identified that the majority of successful studies to date have included both dietary and physical activity intervention components in their design. Interestingly, the study by Bertz et al. (59) consisted of three intervention groups and a comparison group. Their intervention was shown to be effective by 12 weeks and 1 year, for overweight and obese women in the group receiving the diet-focused intervention, compared with the group receiving combined diet and physical activity advice, physical activity advice alone and the control group. In addition, women in the diet intervention group were provided with scales for home use and self-monitoring of weight. Similarly, a recent Australian study, conducted during pregnancy, focused on women measuring their own weight gains and recording personal weight goals, compared with recommendations with the intention to limit excess GWG (70). That study did not include a dietary or physical activity intervention component yet the intervention was successful in limiting GWG for overweight women with a mean difference of 0.12 kg week\(^{-1}\) (95% confidence interval, 0.03-0.22 kg week\(^{-1}\); \(P = 0.01\)). Encouraging women to regularly self-monitor and record their weight might be a simple yet promising strategy to implement as part of future research (71,72).

Two interventions in the current review reported integration of theoretical frameworks in their intervention design to assist in promoting behaviour change (66,67). Both studies included diet and physical activity components as part of their intervention, yet neither approach was successful in showing significant differences in weight lost between control and intervention groups. However, theory-based interventions have previously been regarded as offering multiple advantages over theoretical interventions (73,74) including reduced intervention dosage and increased likelihood of behaviour change (73,74). As such, they are an important consideration in the design of future behavioural interventions to promote healthy postpartum weight attainment.

Retention rates for the majority of studies included in the current review (59-61,64,66,68,69) were high (>80%), adding strength to our conclusions. While the majority of studies in this review did not report recruitment response rates (59-63,65,68), small sample sizes evident across studies might reflect difficulty faced in recruiting first-time mothers, despite women having previously been found to report high motivation to address their weight status postnatally (50,75). However, new mothers are often faced with untried challenges accompanied by a shift in focus from their own lifestyle to caring for their new infant. This might present as a barrier to recruitment for future research and considerations of potential to maximize engagement should be a priority when considering intervention design. In addition, strategies that address additional barriers such as lack of partner support, mothers returning to work, difficulties with childcare options and strong social expectations of the role of a new mother should also be considered (76,77).

With women having previously been found to be unwilling to attend weekly group meetings, even when child support was readily available (63), home-based settings might be considered an ideal environment for delivery of healthy weight interventions. For example, in the study conducted by Østbye et al. (67) included in this review, women attended an average of 3.8 out of 8.0 healthy eating classes and completed an average of 3.3 out of 6.0 individual telephone counselling sessions over a 9-month period. The intervention was not effective in achieving weight loss in the largest sample size recruited of all studies included in this review. The authors of that study recommend that home-based interventions may be a more feasible and suitable setting for intervention in this population group (67). Home-based interventions may provide a less burdensome, more practical and ultimately more engaging approach than clinic-based attendance, for future provision of weight loss support for new mothers following the birth of their child (67).

Coupled with the provision of home-based support, interventions delivered via mail/post, email, telephone, text messaging or the Internet might be even more practical than traditional face-to-face methods. Such modes of delivery for weight loss support have been successful when implemented as part of interventions in the non-obstetric population (78-80). For instance, delivery of weight loss intervention via mobile phone text messaging has been shown to be an acceptable and successful approach for weight loss (78,79) and has the capacity to be widespread at a relatively low cost compared with face-to-face counselling.

Moreover, web-based weight management programmes have the potential to minimize participation burden associated with group counselling or clinic visits (81,82) and have been found to be as successful as traditional face-to-face counselling for short-term weight loss (83). While mobile and Internet technologies offer unprecedented opportunities to expand how health promotion
information is conveyed to new mothers (84), delivery of support via technology-mediated methods, either alongside or alternate to traditional face-to-face counselling were utilized in a few studies in our review. One study utilized text messaging support as part of a 12-week intervention (59). Participants in the group that showed significant weight loss by 12 weeks, which was sustained 9 months post-intervention, were contacted biweekly via text message to report body weight throughout the study duration. One other study in this review utilized an online intervention component in the MyPyramid dietary tool combined with provision of email support (60). While a focus of the study was to improve total diet and food consumption patterns in overweight and obese women, the programme was effective in promoting weight loss compared with minimal care (60). In addition to mobile- and Internet-delivered interventions, new mothers might be a suitable target population for delivery of weight loss programmes through blogging or social media such as Facebook and Twitter. They have been previously referred to as a population subgroup immersed in new age media (85), and as such, these innovative methods of intervention delivery could be a promising approach to weight loss for new mothers.

In addition, few studies reviewed included waist circumference measures as an anthropometric outcome. This is surprising as weight retention as a result of GWG tends to be centrally deposited rather than peripherally deposited (45–47), and because overweight and central fat distribution are well-established risk factors for morbidity and mortality, assessment of central adiposity following childbirth is highly relevant from a long-term public health perspective (45). Future interventions should include assessment of waist circumference in addition to postpartum weight change to assist in careful monitoring of risk factors for obesity and related chronic disease, such as cardiovascular disease and type 2 diabetes.

A limitation of this review was the exclusion of meta-analysis being undertaken to analyse combined study results. The wide variation in intervention design across studies and the heterogeneity in approaches to intervention delivery did not allow for a substantial pooling of average results (86). This is a key consideration for future assessment of intervention studies in this field.

Finally, as studies included in this review focused primarily on Caucasian women and socially disadvantaged samples were not accounted for due to a lack of intervention studies examining such population subgroups. Therefore, findings from this review may not be applicable to diverse communities and as such future work could focus on interventions designed specifically for diverse ethnic groups as well as incorporating diverse communities.

Conclusions

The postpartum period presents as an important life stage to influence long-term obesity risk as well as maternal weight status for subsequent pregnancies. This review has shown that interventions that include both diet and physical activity components and include individualized support are more likely to be successful in promoting healthy postpartum weight. Despite remaining uncertainties into the ideal approach to provision of support for healthy weight attainment, interventions that have utilized modern technologies have shown promise in their capacity to limit PPWR. Future high-quality intervention studies targeting PPWR are needed.

Conflict of interest statement

The authors report no potential conflicts of interest.

Acknowledgements

Paige van der Pligt is funded by a National Health and Medical Research Council (NHMRC) Postgraduate Scholarship; Jane Willcox is funded by a Sidney Myer Health Postgraduate Scholarship; Kylie Hesketh is funded by a National Heart Foundation of Australia Career Development Award (CR 08M 3907); Kylie Ball is funded by a NHMRC Principal Research Fellowship (ID 1042442); and Shelley Wilkinson is funded by a NHMRC Translating Research into Practice Fellowship.

References

33. Ferrari RM, Siega-Riz AM, Eveson KR, Moo M, Melvin CL, Herring AH. Provider advice about weight loss and physical
54. Amorim AR, Linne YM, Lourenco PM. Diet or exercise, or both, for weight reduction in women after childbirth. Cochrane Database Syst Rev (Online) 2007; (3): CD005627.

© 2013 The Authors

obesity reviews © 2013 International Association for the Study of Obesity

A16
Appendix 2

Publication: Opportunities for primary and secondary prevention of excess gestational weight gain: General Practitioners' perspectives
Opportunities for primary and secondary prevention of excess gestational weight gain: General Practitioners’ perspectives

Paige van der Pligt1*, Karen Campbell1, Jane Willcox1, Jane Opie2 and Elizabeth Denney-Wilson3

Abstract

Background: The impact of excess gestational weight gain (GWG) on maternal and child health outcomes is well documented. Understanding how health care providers view and manage GWG may assist with influencing healthy gestational weight outcomes. This study aimed to assess General Practitioner’s (GPs) perspectives regarding the management and assessment of GWG and to understand how GPs can be best supported to provide healthy GWG advice to pregnant women.

Methods: Descriptive qualitative research methods utilising semi-structured interview questions to assess GPs perspectives and management of GWG. GPs participating in shared antenatal care in Geelong, Victoria and Sydney, New South Wales were invited to participate in semi-structured, individual interviews via telephone or in person. Interviews were digitally recorded and transcribed verbatim. Data was analysed utilising thematic analysis for common emerging themes.

Results: Twenty eight GPs participated, 14 from each state. Common themes emerged relating to awareness of the implications of excess GWG, advice regarding weight gain, regularity of gestational weighing by GPs, options for GPs to seek support to provide healthy lifestyle behaviour advice and barriers to engaging pregnant women about their weight. GPs perspectives concerning excess GWG were varied. They frequently acknowledged maternal and child health complications resulting from excess GWG yet weighing practices and GWG advice appeared to be inconsistent. The preferred support option to promote healthy weight was referral to allied health practitioners yet GPs noted that cost and limited access were barriers to achieving this.

Conclusions: GPs were aware of the importance of healthy GWG yet routine weighing was not standard practice for diverse reasons. Management of GWG and perspectives of the issue varied widely. Time efficient and cost effective interventions may assist GPs in ensuring women are supported in achieving healthy GWG to provide optimal maternal and infant health outcomes.

Keywords: General Practitioner, Gestational weight gain, Pregnancy, Qualitative, Antenatal

Background

The prevalence of overweight and obesity are increasing among women of childbearing age [1], mirroring rising rates of these conditions in the general population. In the Australian context an estimated 34% of the Australian obstetric population have a body mass index (BMI) greater than 25 kg/m²[2]. Similar rates are seen in the United Kingdom with 25% of women overweight and over 15% obese during the first trimester of their pregnancy [3]. In the United States 60% of mothers begin their pregnancy overweight or obese [4]. Some evidence suggests that excess GWG is more common in women who begin their pregnancy at a BMI higher than the normal range [5]. Mean GWGs have increased in developed countries over recent decades [6,7] and the impact of excess gestational weight has gained increased attention. There are currently no Australian recommendations for GWG, however the US Institute of Medicine

* Correspondence: p.vanderpligt@deakin.edu.au
1Centre for Physical Activity and Nutrition Research, Deakin University, Melbourne, Australia
Full list of author information is available at the end of the article

© 2011 van der Pligt et al; licensee BioMed Central Ltd. This is an Open Access article distributed under the terms of the Creative Commons Attribution License (http://creativecommons.org/licenses/by/2.0), which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.
Excess weight gain during pregnancy places both mother and child at increased risk of serious health complications [9-12] and has been linked with increased risk of caesarean section [13], gestational hypertension and augmentation of labour [14], preeclampsia [15] and gestational diabetes mellitus [16]. There appears to be a higher risk for adverse pregnancy outcomes when excess GWG is combined with high pre pregnancy maternal BMI. Excess GWG is also associated with increased and persistent postpartum overweight [17,18] which in turn may impact on early termination of breastfeeding [19], on weight trajectories for subsequent pregnancies, and on later BMI [20].

Emerging evidence suggests that excess GWG is associated with increased offspring obesity. In addition to excess GWG, multiple studies have shown that maternal obesity is also a major risk factor for childhood obesity [21-23]. Increased child adiposity has been correlated with excess GWG in neonates and young children [24], in adolescence [25] and in adults at 21 years of age [26]. The high prevalence of child overweight and obesity, coupled with the knowledge that child weight tracks strongly through life prompts us to better understand all opportunities to promote healthy child weight. Understanding how and why clinicians and other health care providers might incorporate management of GWG into their antenatal care is important in maximising prevention of excess GWG during this opportune period.

While the delivery of prenatal care will differ across countries, a number of health professionals, including physicians, midwives and obstetricians consistently deliver such services throughout pregnancy [27]. In Australia, women often choose to have their antenatal care shared between their GP and Obstetrician, known as shared care. With many occasions to engage women at this time, clear opportunities to support women to achieve positive lifestyle changes that may promote healthy GWGs exist. While these health care providers are likely to be central in promoting such changes, little is known about the ways in which such professionals engage on these issues across pregnancy [28].

In particular, General Practitioners (GPs) have been identified as vital contributors to the treatment of overweight and obesity in the non-pregnant population [29,30] and have elsewhere been described as “gatekeepers to the health system”, with the opportunity to play a key role in addressing obesity within consultations [31]. Given women will be seeking advice from their healthcare provider frequently during pregnancy and given that GWG is a common and natural progression of pregnancy, early support is likely to be important. The first antenatal visit is often to the GP [32] and hence GPs may provide a key opportunity to influence GWG. General Practitioners specifically participating in shared antenatal care have frequent contact with women throughout their pregnancies and offer specialised obstetric care up until the labour. As such their perspectives on managing gestational weight gain are highly relevant and may help to inform future antenatal practice.

Few studies exist focusing on the views of antenatal healthcare professionals regarding gestational weight management and impact [33] and, to the authors’ knowledge, no studies have focused on GPs’ perspectives regarding opportunities for prevention of excess GWG. Understanding the ways in which health care providers currently view and manage gestational weight is fundamental to realising this potential. Therefore, the aims of this study were to 1) document the experience of GPs in the assessment and management of women entering pregnancy already overweight, 2) to assess GPs’ perceived role in the promotion of healthy GWG more broadly and 3) to understand GPs’ views regarding the ways in which they may be supported to promote healthy GWG.

**Methods**

**Participants**

General Practitioners in Geelong participating in shared antenatal care were identified by telephoning all medical practices from a practitioner list provided by the GP Association of Geelong. Information was obtained regarding whether or not the GP was a participant of shared antenatal care. In Sydney, two divisions of general practice were contacted from where a list of GPs participating shared antenatal care was obtained. In quantitative studies, generalizability is achieved via statistical sampling procedure, however such sampling procedures are mostly unavailable in qualitative research [34]. In our study, purposive sampling was used for participant selection allowing the selection of relatively

<table>
<thead>
<tr>
<th>Pre pregnancy Weight category</th>
<th>Pre pregnancy BMI</th>
<th>Recommended pregnancy weight gain based on IOM guidelines</th>
</tr>
</thead>
<tbody>
<tr>
<td>Underweight</td>
<td>&lt; 18.5 kg/m²</td>
<td>12.5 - 18 kg</td>
</tr>
<tr>
<td>Normal weight</td>
<td>18.5 - 24.9 kg/m²</td>
<td>11.5 - 16 kg</td>
</tr>
<tr>
<td>Overweight</td>
<td>25 - 29.9 kg/m²</td>
<td>7 - 11.5 kg</td>
</tr>
<tr>
<td>Obese</td>
<td>≥30 kg/m²</td>
<td>5 - 9 kg</td>
</tr>
</tbody>
</table>
small [35] information rich cases for study in depth to illuminate the questions under study [36]. All GPs identified as being antenatal shared care providers in the Geelong, Victoria region by the GP Association of Geelong (n = 175) along with a randomly selected sample of 131 Sydney GPs from the Central Sydney GP Network providing shared care (out of a possible 489), were invited by personal letter to participate. All GPs who replied to the invitation were telephoned by research staff and an interview time was scheduled either via telephone (Sydney GPs) or face to face (Geelong GPs) at a time and location convenient to the GP. They were provided with a plain language statement and consent form either via email or post and all participants provided written, informed consent to participate and have the interview digitally recorded. Consent forms were collected via facsimile from each GP clinic on the day of the interview prior to the interview being conducted. Participating practitioners were reimbursed with a store voucher to the value of one hundred dollars in appreciation of their time. Ethics approval for this study was obtained from the Deakin University and the University of New South Wales Human Research Ethics Committees.

Data collection and analysis
A descriptive qualitative approach was used in this study to understand more deeply the views of GPs regarding their management of excess GWG. Methods of qualitative description as described by Sandelowski [37,38] were employed. Key design features of qualitative description include maximum variation in sampling, data collection through interviews and qualitative analysis. It also offers a descriptive validity of the situation, that is, an accurate accounting of the events that most people observing the event would agree is accurate. Overall, qualitative interviews provide a flexible approach enabling a probing assessment of a topic. This approach seeks to uncover ideas or concepts that may not have been anticipated at the outset of their research [39].

Individual interviews were employed to enable flexibility and best opportunity to engage with the GP. Interviews were conducted face to face in the Geelong region as this was the main location of the research team and Sydney GPs were interviewed via telephone. Research comparing the reliability and validity of face-to-face and phone interviews has shown a high level of agreement [40]. Semi-structured interviews were employed to ensure all questions (see Table 2) were addressed and this technique enabled comparability of data [41]. The interviews took no more than 30 minutes to complete and were conducted by a researcher trained in qualitative interview techniques. All interviews were transcribed verbatim by an online transcribing company.

Table 2 Interview Questions

<table>
<thead>
<tr>
<th>Question</th>
<th>1. How many pregnant women would you see on average per year?</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.</td>
<td>In your view, what are the 3 - 5 most important things you think should be covered in a (the first) consultation with a pregnant woman?</td>
</tr>
<tr>
<td>3. (a)</td>
<td>At what point in the pregnancy do women generally present to primary care practitioners?</td>
</tr>
<tr>
<td>(b)</td>
<td>And what about subsequent consultations?</td>
</tr>
<tr>
<td>4.</td>
<td>How many consultations would there usually be and what is the focus of subsequent consultations?</td>
</tr>
<tr>
<td>5. (a)</td>
<td>How often are women weighed throughout their pregnancies?</td>
</tr>
<tr>
<td>(b)</td>
<td>Is BMI at first presentation calculated?</td>
</tr>
<tr>
<td>(c)</td>
<td>Is weight trajectory plotted?</td>
</tr>
<tr>
<td>6. (a)</td>
<td>Is advice regarding anticipated gestational weight gain offered?</td>
</tr>
<tr>
<td>(b)</td>
<td>If no, is there a reason for this?</td>
</tr>
<tr>
<td>(c)</td>
<td>Does this take into account BMI at commencement of pregnancy?</td>
</tr>
<tr>
<td>7.</td>
<td>If a woman is overweight at first presentation, are you more likely to assess, advise and/or refer for weight management or healthy eating or physical activity education? How would this be done?</td>
</tr>
<tr>
<td>8.</td>
<td>What are the triggers that alert you to excess gestational weight gain and increased risk?</td>
</tr>
<tr>
<td>9.</td>
<td>In your mind, what do you consider to be the most important implications of overweight and obesity in pregnancy and of weight gain in excess of recommendations?</td>
</tr>
<tr>
<td>10.</td>
<td>Do you undertake any assessment of lifestyle behaviours? If so, which lifestyle behaviours do you assess?</td>
</tr>
<tr>
<td>11. (a)</td>
<td>In a perfect scenario, how do you imagine you would be best supported to provide healthy lifestyle advice and support to pregnant women?</td>
</tr>
<tr>
<td>(b)</td>
<td>Do you think that support via the internet, mail or telephone would be useful for weight management advice or healthy lifestyle advice in supporting both yourself and also the pregnant woman?</td>
</tr>
<tr>
<td>12.</td>
<td>What sort of information do women mostly seek about their pregnancy and does this ever include weight gain advice?</td>
</tr>
<tr>
<td>13. (a)</td>
<td>Is there much/any interaction with other members of the antenatal team within the practice (such as nurses) regarding weight monitoring or management?</td>
</tr>
<tr>
<td>(b)</td>
<td>If so, how does this happen?</td>
</tr>
</tbody>
</table>
Thematic analysis was used to assess repeated practices and perspectives across all data. The data were analysed firstly by 6 randomly selected transcripts being read and analysed independently by two of the researchers (PV and JW) to ensure that coding and identification of emerging themes was in agreement. Analysis of the 14 Sydney transcripts was undertaken by KC, and the remaining 14 Geelong transcriptions were analysed by JW. All transcriptions were then re – analysed by PV to ensure consistency. Interview responses made by the GPs were grouped into categories relating to their content. For example, time for first appointment, reasons/ thoughts on weighing and not weighing, weight gain advice, referrals, barriers to weighing, support, health consequences etc. Anonymity of participants was maintained through the use of de - identified data.

Results
Participants
A total of 32 GPs responded to the invitation letter and two of these GPs did not schedule an interview as they were not contactable. Thirty GPs scheduled an interview however 2 GPs were not available at the time of the telephone interview and subsequently did not participate in the study. Twenty eight GPs took part in the interviews, 14 were from Geelong, and 14 from Sydney. GPs were from 22 different clinics within the Greater City of Geelong and metropolitan Sydney and the practices represented a range of socio demographic regions. No GPs withdrew from the study and data from all 28 interviews were included in the analyses. Data was collected until data saturation occurred, that is, when the number of samples have effectively addressed all aspects of the emerging themes and phenomenon with optimal data quality [42].

Themes
The GPs’ responses clustered into five broad themes: (i) GPs own awareness of the issues/identifiable problems of overweight/obesity/excess weight gain; (ii) provision of advice regarding GWG and healthy lifestyle behaviour advice; (iii) attitudes and practices around routine gestational weighing; (iv) practical barriers to management; (v) how GPs feel they could be best supported. Randomly selected quotes are presented by these themes in Table 3.

Awareness of the issues/identifiable problems of overweight/obesity/excess weight gain
General Practitioners identified that excess GWG and gestational overweight and obesity adversely affects both the mother and child and the majority of GPs reported that gestational diabetes was one of the most important implications of excess GWG, overweight or obesity in pregnancy. General Practitioners frequently identified pre - eclampsia, hypertension and delivery complications as major implications of excess GWG and maternal overweight and obesity.

Other adverse complications identified infrequently included higher rates of miscarriage, increased rates of unplanned caesarean section, general unspecified obstetric complications, maternal morbidity or mortality, conditions of fatigue, high cholesterol, decreased cardiac fitness, post natal depression and chronic diseases later in life and excessive weight in the post partum period.

General Practitioners recognised varied child health outcomes associated with excess GWG and maternal overweight and obesity including macrosomia, foetal abnormalities and an inability of the practitioner to palpate and examine the baby thus placing the child at higher risk of undetected abnormalities. Few GPs identified child overweight or obesity in the long term as being amongst the most important identifiable problems.

Provision of advice regarding gestational weight gain and healthy lifestyle behaviour advice
Advice regarding recommended GWG was not consistent and GPs rarely took into account BMI at the start of pregnancy when offering advice. Amount to gain in pregnancy ranged from 8 kg to 15 kg for normal weight women and a small proportion of GPs offered no weight gain advice or offered advice only when asked by the women.

Other than specific nutrient advice and nutrition recommendations for pregnancy, GPs considered general healthy eating advice (in the absence of exercise advice) among the most important topics that should be covered in the initial consultation with the pregnant woman rarely. They infrequently provided exercise advice during pregnancy (in the absence of general healthy eating advice) or mentioned that both general healthy eating advice as well as exercise advice should be given in the first consultation. GPs rarely reported that gestational weight would be among the most important issues to be discussed at the first appointment.

Attitudes and practices around routine gestational weighing
Weighing practices differed among GPs and most GPs weighed women occasionally throughout their pregnancies. Only a small proportion of GPs weighed women at every visit and few GPs weighed at the first consultation only or never. Attitudes towards weighing varied and there was a clear division in comments provided by the GPs for and against weighing, highlighting a distinct division surrounding usefulness and appropriateness of weighing.
Table 3 Emerging themes and a sample of supporting verbatim quotes

<table>
<thead>
<tr>
<th>Themes</th>
<th>Verbatim quotes</th>
</tr>
</thead>
</table>
| Awareness of the issues/identifiable problems of overweight/obesity/excess weight gain | “But certainly weight is important, and mostly because of gestational diabetes. Really because that impacts on the mother and the baby, and the whole birth outcome.”(GP005)  
“Well, gestational diabetes definitely. Possibility pregnancy induced hypertension. And also just complications with delivery because like if, for example they need to have a caesarean, I mean that’s going to be really difficult if they’re really obese, so, yes, sort of delivery complications as well.”(GP026)  
“Well yes there is evidence that it affects the foetus and the wellbeing of the child in future life.”(GP016)  
“So I do normally tell the overweight woman about the implication of the long term health problem, plus the implication for young children, because whatever you’re doing, your children will be doing the same.”(GP018)  
“But obviously children will be obese if mum puts on weight, and keeps going putting on weight or something.”(GP017) |
| Provision of advice regarding gestational weight gain and healthy lifestyle behaviour advice | “Actually I’m not quite sure how much is too much. Well certainly gaining to...like 20 kg, that’s probably too much.”(GP019)  
“I mean we used to work on the sort of one and a half kilograms a month was acceptable. But then when you’ve got people that are perhaps overweight or obese to start with, we always tried to keep their weight gain at a lot less than that.”(GP006)  
“...there’s a feeling that exercise during pregnancy may be harmful, particularly in early pregnancy, and to encourage them to keep exercising, I think, is also helpful.”(GP006)  
“Actually, when women are pregnant, they’re actually very receptive to lifestyle and healthy lifestyle advice.”(GP012) |
| Attitudes and practices around routine gestational weighing | “So I think that weight wasn’t a good indicator of maternal or foetal wellbeing, so I think it fell out of favour.”(GP005)  
“I noticed that on the shared care antenatal chart established by the hospital the column for weight has disappeared.”(GP006) |
| Practical barriers to weighing | “I’m not sure what the reason why not weighing.”(GP008)  
“Weighing (as standard practice) is coming back.”(GP005)(GP007)(GP010)  
“Weighting pregnant women is actually very useful when it comes to pre eclampsia.”(GP003) |
| How GPs feel they could be best supported | “I think time is the most significant thing because (I) always have to rush to see patients.”(GP019)  
“Space, time, funding, who’s going to organise it? So all the organisational and implementation issues.”(GP019) |
| Practical barriers to management | “So, I guess from my point of view it’s not just what the doctor says, it’s what other health professionals can offer, and motivation.”(GP010)  
“If there was a Dietitian attached to this clinic that would be readily available, that would be marvellous, because any woman who I even eyeball to be overweight and therefore at risk of gestational diabetes, I would talk to them about healthy eating in pregnancy and risk of gestational diabetes, and I refer most of my women to this Dietitian.”(GP005)  
“...so having access to either a Dietitian or an Exercise Physiologist, or both, that we’d be able to send people to would be good.”(GP028)  
“And so you know that people don’t remember a lot about a consultation, and so like I say, some written information I think is always good.”(GP004)  
“I think that would be a really helpful thing if it was on different aspects of the pregnancy. Because mail - outs or emails, I think that pregnant women are very - they’re very centred on doing everything right.”(GP011) |

**Practical barriers to management**

When GPs were asked about barriers that prevent provision of support to provide healthy lifestyle advice and manage GWG, responses were mixed with approximately one third of GPs mentioning cost to the patient as a financial barrier to provision of additional support, and very few GPs reporting cost as a barrier to hire additional clinicians at the medical practice. Other barriers mentioned by few GPs included lack of space for additional practitioners at the clinic, lack of GP time and short consultation periods and lack of organisational structure within the practice including extensive patient waiting lists as well as patients for weight management being sent to the hospital diabetes clinic and therefore further GP support not being required.

**How GPs feel they could be best supported**

The majority of GPs reported being more likely to assess, advise and or refer for weight management to other health practitioners if the woman was overweight.
Discussion

This study aimed to examine the perspectives of GPs participating in shared antenatal care regarding GWG and to understand opportunities for primary and secondary prevention of excess GWG. To our knowledge this was the first study to investigate how GPs feel they would be best supported to provide healthy lifestyle advice to pregnant women and healthy GWG management. This study suggests that these GPs had mixed views regarding the management and prevention of excess GWG, demonstrated by their reported recommendations for weight gain in pregnancy, weighing practices and views regarding maternal and child health complications associated with excess GWG being highly varied.

As revealed in this study, there is uncertainty regarding the need or even the desirability to weigh pregnant women in GP consultations. Over a third of GPs in our study either did not weigh at all or weighed only when asked to by the patient. The barriers to weighing women in pregnancy identified in this study were time restraints and uncertainty regarding what advice to give regarding weight gain. Similar findings are reported by Olander et al [3] in a study where focus groups and interviews assessed health practitioners (midwives, social workers and antenatal care centre managers) views regarding GWG [3].

The advice regarding the amount of weight to gain in pregnancy varied widely. This is perhaps not surprising as there are no formal recommendations for GWG in Australia. Women who are informed of their own target for gestational weight gain, however, have been found to be more likely to gain within recommended IOM ranges [43]. The inconsistency in approach regarding GWG advice in our study reflects findings from a Dutch study [44] where advice received by 144 pregnant women was assessed. In that study, 12% of participants reported receiving no advice for weight gain from their health care provider, 23% received weight gain advice that was higher than IOM recommendations and 5% received advice that was below recommendations [44]. Further, the majority of women who were overweight or obese pre pregnancy, were advised to gain weight in excess of IOM recommendations [44].

In the non-pregnant population, provision of advice from primary care practitioners incorporating weight gain targets has been found to be an effective strategy in weight management [45]. Potter et al [45] surveyed 366 adult patients from 2 primary care practices and found that one of the components the patients reported most wanting to help them achieve successful weight loss was physician help in setting realistic weight goals. Whilst intervention studies incorporating provision of recommendations for weight gain in pregnancy as part of their intervention component are scarce [45-50] and have produced mixed results, setting realistic weight gain targets in shared antenatal care for women could be a promising step in providing support aimed at preventing excess GWG.

Despite inconsistencies in GWG advice, GPs in this study frequently acknowledged the impact of excess GWG, overweight and obesity on maternal and child health outcomes. Maternal conditions (gestational diabetes, pregnancy induced hypertension, and pre-eclampsia) were more frequently reported as co-morbidities of excess GWG than were implications for the child (macrosomia, foetal abnormalities and higher risk of undetected foetal abnormalities). Interestingly, long term child health conditions including offspring overweight and obesity and childhood diabetes were infrequently acknowledged as risks associated with excess GWG.

Recent longitudinal studies suggest that long-term adverse effects on offspring weight and body fatness are important correlates of excess GWG. For example in a prospective study of more than 1000 mother-child pairs, Oken et al [23] reports that mothers with greater GWG had children with greater adiposity at age 3, measured by BMI(OR 1.30, 95% CI: 1.04, 1.62 for each 5 kg) and sub scapular and triceps skin fold thickness(0.26 mm, 95% CI: 0.02, 0.51) [23]. In addition, Reynolds et al [22] examined whether maternal body composition and GWG had persisting effects in 276 offspring at 30 years of age. They found that body fat percentage was higher in offspring of mothers with a greater BMI at the first antenatal visit and that higher offspring body fat percentage was independently associated with higher pregnancy weight gain (7.4%/kg/wk; p = 0.002). Similar significant associations of greater pregnancy weight gain...
with greater offspring waist circumference, BMI and fat mass at age 30 were also seen [22]. Further, Wrotniak et al [51] reported in a retrospective cohort study of 10,266 mothers that the odds of overweight in offspring at age 7 years increased by 3% for every 1 kg of excess GWG. Prevention of the onset of early childhood overweight is important for public health and is therefore an important consideration for maternal weight gain advice in antenatal care.

Antenatal care has previously been described as an opportune time for healthcare providers to assist women in altering lifestyle affecting weight, nutrition and physical activity [27]. Given that pregnant women are highly motivated to achieve the best outcomes for their child [52], GP advice regarding lifestyle behaviours would ideally be a particularly important component of shared antenatal care. In this study, very few GPs offered both general healthy eating and exercise advice as part of the first consultation. GPs reported a multidisciplinary approach utilising input from allied health professionals would provide the most useful support. Referral to a Dietitian for healthy lifestyle advice and weight management was frequently suggested as the preferred approach. However, there are multiple barriers to the provision of additional health practitioners input which includes increased cost to the patient, to the medical practice itself and to the health system, lack of physical capacity within the medical practice to employ additional practitioners and lack of organisational structure required for additional consulting, all of which were highlighted by GPs in this study.

One alternative approach may be the provision of an Australian government subsidised (Medicare) allied health Enhance Primary Care (EPC) plan, offered to pregnant women for healthy weight and lifestyle management. In the current Australian Medicare system, EPC plans allow for a limited number of GP referred visits per year to allied health practitioners. Patients must be diagnosed with a chronic disease, such as obesity, alongside resulting co-morbidities (for example hypertension or hypercholesterolaemia), and are referred for management of these specific conditions. However pregnancy, subsequent excess weight gain and pregnancy induced co-morbidities does not qualify for management under the government subsidised EPC plan yet long term health benefits and public health savings could potentially justify this scheme for pregnant women.

Limitations of the study included the structure of qualitative data collection through interviews. Assumptions might be made that individual participants have the capacity to reflect and interpret the situation and their actions. Offering the option of telephone interviews to cover accessibility issues may result in interaction not as intimate as face-to-face interviews and does not allow the researcher an opportunity to observe the informant’s responses. However interviews do allow participants space to provide information, including historical information, verbally and give the researcher control over line of questioning [53] and this was an efficient method used to access busy GPs in a distant location, from whom we may not have otherwise been able to gain information.

Opportunities to help address some of the existing barriers to employing additional health care providers as a referral point for GPs may lie with more cost effective and time efficient avenues of support. Perhaps GP referral to internet resources, telephone support or written education material that provides useful and reliable healthy lifestyle advice for pregnant women in the management of GWG could be beneficial.

Conclusion
General Practitioners frequently participating in shared antenatal care identify many adverse maternal and child health outcomes associated with excess GWG, however, management of excess GWG and perspectives of the issue vary widely. From a public health perspective, health care practitioners such as GPs are vital in promoting awareness of the importance of healthy GWG. Strategies to best support GPs in their management of GWG are needed so that best outcomes are achieved for maternal and child health. Further research into how best to support GPs participating in shared antenatal care, along with women during their pregnancy, is needed to help promote healthy GWG.

Acknowledgements
Karen Campbell is supported by a Victorian Health Promotion Foundation Fellowship

Author details
1Centre for Physical Activity and Nutrition Research, Deakin University, Melbourne, Australia. 2General Practitioners Association of Geelong, Geelong, Australia. Centre for Primary Health Care and Equity, University of New South Wales, Sydney, Australia.

Authors’ contributions
PV was responsible for co-ordination of the study, all data collection, contributed to data analyses and drafted the manuscript, KC conceived of the study contributed to its design, contributed to data analyses and helped draft the manuscript, JW contributed to the data analyses and helped draft the manuscript, JO contributed to the recruitment process of GPs in Geelong involved in the study, EDW contributed to the recruitment of GPs in Sydney and to the design of the study. All authors read and approved the final manuscript.

Competing interests
The authors declare that they have no competing interests.

Received: 1 August 2011 Accepted: 4 November 2011
Published: 4 November 2011

References


Pre-publication history
The pre-publication history for this paper can be accessed here:
http://www.biomedcentral.com/1471-2296/12/124/prepub

doi:10.1186/1471-2296-12-124

Cite this article as: van der Pligt et al.: Opportunities for primary and secondary prevention of excess gestational weight gain: General Practitioners’ perspectives. BMC Family Practice 2011 12:124.
Appendix 3
InFANT Extend trial
Main Carer Survey (Baseline)
Welcome to the INFANT Study

This survey aims to gather information about you and your baby. We mostly ask about your thoughts and practices around food, feeding your baby and physical activity.

Thank you for taking the time to complete the survey. It will take you about 30-40 minutes to complete, although this might vary depending on your answers. Once you have finished your survey, please bring it with you to your first INFANT session.

Privacy and confidentiality
The information you provide in the survey is completely confidential. All completed surveys will be kept in secure storage at Deakin University.

Contact details
Please contact Lily Meloni if you have any questions about the survey.

Lily Meloni: ph: (03) 52278776
email: lily.meloni@deakin.edu.au
Important Instructions – Please Read

Please answer each question by shading the most suitable option.
Where you are asked to write an answer please answer in the space provided.
If you are unsure about how to answer a question, please choose the answer that is closest to how you feel. Please do not leave questions unanswered.

Please answer questions in the following way:

**Fill in the circles clearly like this:**
In general, would you say your health is: (shade one response only)

<table>
<thead>
<tr>
<th>Poor</th>
<th>Fair</th>
<th>Good</th>
<th>Very good</th>
<th>Excellent</th>
</tr>
</thead>
<tbody>
<tr>
<td>$O_1$</td>
<td>$O_2$</td>
<td>$O_3$</td>
<td>$O_4$</td>
<td>$O_5$</td>
</tr>
</tbody>
</table>

You would shade this circle if you think your health is good

**Print clearly in the boxes or on lines provided like this:**
What is your postcode? (PRINT clearly on the line)

3125

**Correct mistakes like this:**
In general, would you say your health is: (shade one response only)

<table>
<thead>
<tr>
<th>Poor</th>
<th>Fair</th>
<th>Good</th>
<th>Very good</th>
<th>Excellent</th>
</tr>
</thead>
<tbody>
<tr>
<td>$O_1$</td>
<td>$O_2$</td>
<td>$O_3$</td>
<td>$O_4$</td>
<td>$O_5$</td>
</tr>
</tbody>
</table>

If you make a mistake cross it out and clearly mark the correct answer by shading the circle.
SECTION A: ABOUT YOUR BABY

QA1 What is today’s date?

______/______/20____ (dd/mm/yyyy)

QA2 What is your baby’s date of birth?

______/______/20____ (dd/mm/yyyy)

QA3 Is your baby a: (Please shade one response only.)

<table>
<thead>
<tr>
<th>Boy</th>
<th>Girl</th>
</tr>
</thead>
<tbody>
<tr>
<td>O₁</td>
<td>O₂</td>
</tr>
</tbody>
</table>

QA4 Is this your first born baby? (Please shade one response only.)

<table>
<thead>
<tr>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>O₁</td>
<td>O₂</td>
</tr>
</tbody>
</table>

QA5 How long did this pregnancy last? (On average a pregnancy lasts about 40 weeks)

_______ weeks & _______ days

QA6 Does your baby have a disability? (Please shade one response only.)

If YES, please specify: __________________________

<table>
<thead>
<tr>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>O₁</td>
<td>O₂</td>
</tr>
</tbody>
</table>

QA7 Looking at your baby’s Child Health Record (blue book), please go to the Birth, Vitamin K and Hepatitis B, Newborn Examination section, and copy figures for weight, height and head circumference, at the ages listed, into the table below

<table>
<thead>
<tr>
<th>Age of child</th>
<th>Weight (g)</th>
<th>Height(cm)</th>
<th>Head circumference (cm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Birth</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2 weeks</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4 weeks</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8 weeks</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

QA8 During a typical week, is your baby cared for by someone other than you or your partner? (Please shade one response only.)

<table>
<thead>
<tr>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>O₁</td>
<td>O₂</td>
</tr>
</tbody>
</table>

Yes O₁ Go to Question A9
No O₂ Go to Section B

QA9 Approximately how many hours per week is your baby cared for by someone other than you or your partner?

_______ hours
SECTION B: FEEDING YOUR BABY

QB1 Has your child ever had breastmilk? (Please shade one response only.)

*Note: Include colostrum, expressed breastmilk and breastmilk from a donor or donor milk bank*

<table>
<thead>
<tr>
<th>Yes</th>
<th>☐ 1</th>
<th>Go to Question B2</th>
</tr>
</thead>
<tbody>
<tr>
<td>No</td>
<td>☐ 2</td>
<td>Go to Question B3</td>
</tr>
</tbody>
</table>

QB2 Apart from breastmilk, has your child ever had any other fluids or food? (Please shade one response only.)

*Note: Include any water, infant formula products, other milks and solids*

<table>
<thead>
<tr>
<th>Yes</th>
<th>☐ 1</th>
<th>How old was your baby when you provided other fluids or food?</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>☐ 9</td>
<td>Go to Question B3</td>
</tr>
<tr>
<td>No</td>
<td>☐ 2</td>
<td>_____ weeks OR Don’t know ☐ 99</td>
</tr>
</tbody>
</table>

QB3 How are you currently feeding your baby? Note we will ask about solid food in the next section. (Please shade one response only.)

<table>
<thead>
<tr>
<th>Breastfeeding exclusively (no other food or fluids)</th>
<th>☐ 1</th>
<th>Go to Question B5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Breastfeeding fully with occasional water and juices</td>
<td>☐ 2</td>
<td>Go to Question B4</td>
</tr>
<tr>
<td>Formula feeding only</td>
<td>☐ 3</td>
<td>Go to Question B4</td>
</tr>
<tr>
<td>Combination breast and formula feeding</td>
<td>☐ 4</td>
<td>Go to Question B4</td>
</tr>
<tr>
<td>Cow’s milk only</td>
<td>☐ 5</td>
<td>Go to Question B4</td>
</tr>
</tbody>
</table>

QB4 What were your reasons for supplementing or replacing breastmilk with other fluids or, if you’re not breastfeeding, for stopping breastmilk? (Please shade all responses that apply to you.)

<table>
<thead>
<tr>
<th>Child was old enough to stop</th>
<th>☐ 1</th>
<th>It did not fit in with my social life</th>
<th>☐ 10</th>
</tr>
</thead>
<tbody>
<tr>
<td>Child was not attaching properly</td>
<td>☐ 2</td>
<td>Expressing milk to feed child was too hard</td>
<td>☐ 11</td>
</tr>
<tr>
<td>Child was biting</td>
<td>☐ 3</td>
<td>Baby feeding too frequently</td>
<td>☐ 12</td>
</tr>
<tr>
<td>Return to work</td>
<td>☐ 4</td>
<td>Baby was unsettled</td>
<td>☐ 13</td>
</tr>
<tr>
<td>Child lost interest</td>
<td>☐ 5</td>
<td>It was too time consuming</td>
<td>☐ 14</td>
</tr>
<tr>
<td>Not enough breastmilk for child</td>
<td>☐ 6</td>
<td>My partner preferred I stopped</td>
<td>☐ 15</td>
</tr>
<tr>
<td>It was time for the child to have other foods</td>
<td>☐ 7</td>
<td>Infant formula as good as breastmilk</td>
<td>☐ 16</td>
</tr>
<tr>
<td>Mastitis</td>
<td>☐ 8</td>
<td>I did not feel comfortable breastfeeding in public</td>
<td>☐ 17</td>
</tr>
<tr>
<td>Breastfeeding was too painful</td>
<td>☐ 9</td>
<td>Other – please specify on the line below:</td>
<td>☐ 18</td>
</tr>
</tbody>
</table>
QB5  Has your baby ever been given solid or semi-solid food? (Please shade one response only.)

<table>
<thead>
<tr>
<th>Yes</th>
<th>O₁</th>
<th>Go to Question B6</th>
</tr>
</thead>
<tbody>
<tr>
<td>No</td>
<td>O₂</td>
<td>Go to Question B9</td>
</tr>
</tbody>
</table>

QB6  At what age was your baby first given solid or semi-solid food regularly? Regularly = more than twice a week for several continuous weeks. (Please shade one response only.)

<table>
<thead>
<tr>
<th>My baby is not having solids regularly</th>
<th>O₀</th>
</tr>
</thead>
<tbody>
<tr>
<td>I gave my baby solids regularly from when s/he was about _____ weeks old</td>
<td></td>
</tr>
<tr>
<td>I don’t know when I started giving solids to my baby regularly</td>
<td>O₉₉</td>
</tr>
</tbody>
</table>

QB7  What was the first solid or semi-solid food that was given to your baby? (Please shade one response only.)

<table>
<thead>
<tr>
<th>Infant cereal</th>
<th>O₁</th>
<th>Bread and rolls</th>
<th>O₈</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rusk</td>
<td>O₂</td>
<td>Biscuits</td>
<td>O₉</td>
</tr>
<tr>
<td>Milk based dessert</td>
<td>O₃</td>
<td>Fresh fruit</td>
<td>O₁₀</td>
</tr>
<tr>
<td>Yoghurt</td>
<td>O₄</td>
<td>Raw vegetables</td>
<td>O₁₁</td>
</tr>
<tr>
<td>Cooked/pureed/mashed fruit</td>
<td>O₅</td>
<td>Other</td>
<td>O₁₂</td>
</tr>
<tr>
<td>Cooked/pureed/mashed vegetables</td>
<td>O₆</td>
<td>Don’t know</td>
<td>O₉₉</td>
</tr>
<tr>
<td>Cooked/pureed/mashed finger food</td>
<td>O₇</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

QB8  Please indicate at what age your baby was first introduced to the following textures. (Please shade one response or write in the appropriate answer for each.)

<table>
<thead>
<tr>
<th>Pureed/smooth food (shop bought or home made)</th>
<th>_____ weeks</th>
<th>Never offered</th>
<th>O₁</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Don’t know</td>
<td>O₉₉</td>
</tr>
<tr>
<td>Food mashed finely</td>
<td>_____ weeks</td>
<td>Never offered</td>
<td>O₁</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Don’t know</td>
<td>O₉₉</td>
</tr>
<tr>
<td>Food mashed with lumps</td>
<td>_____ weeks</td>
<td>Never offered</td>
<td>O₁</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Don’t know</td>
<td>O₉₉</td>
</tr>
<tr>
<td>Food finely chopped</td>
<td>_____ weeks</td>
<td>Never offered</td>
<td>O₁</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Don’t know</td>
<td>O₉₉</td>
</tr>
<tr>
<td>Finger food</td>
<td>_____ weeks</td>
<td>Never offered</td>
<td>O₁</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Don’t know</td>
<td>O₉₉</td>
</tr>
<tr>
<td>Food I have chewed to soften a little</td>
<td>_____ weeks</td>
<td>Never offered</td>
<td>O₁</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Don’t know</td>
<td>O₉₉</td>
</tr>
</tbody>
</table>
The following statements ask about what you think will happen with your baby's eating in the coming months. (Please indicate how much you agree or disagree with the statements by shading one response for each statement.)

<table>
<thead>
<tr>
<th>Statement</th>
<th>Strongly Disagree</th>
<th>Disagree</th>
<th>Agree</th>
<th>Strongly Agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. I think that feeding my baby solids will be easy</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>b. I think that my baby will enjoy many different kinds of vegetables</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>c. I think that my baby will enjoy many different kinds of fruits</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>d. I think that my baby will eat enough vegetables to keep him/her healthy</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>e. I think that my baby will eat enough fruits to keep him/her healthy</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>f. I think I will offer my baby sweetened drinks (e.g. juice or cordial) when the time comes to offer extra fluids</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>g. I think I will offer my baby food treats, such as cake, lollies, or chocolate as a reward for good behaviour</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>h. I think that I will offer my baby sweetened drinks, lollies, chocolate or other snacks by the time they are 12 months old</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>i. I think I will eat my meals at the same time as I feed my baby</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>j. I think that I will encourage my baby to eat some more of their meal if they eat very little at first</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>k. I think I will offer my baby a different kind of food if I find they don’t like what I am offering</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>l. I think it will be difficult to control the kind of foods my family or others will give my baby</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>m. Overall I think I will be satisfied with my baby's eating habits</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
</tbody>
</table>
QB10  About how often are these foods available in your HOME? (Please shade one response on each line.)

<table>
<thead>
<tr>
<th></th>
<th>Never</th>
<th>Sometimes</th>
<th>Usually</th>
<th>Always</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. Fruits</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>b. Vegetables</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>c. Cakes/doughnuts/sweet biscuits</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>d. Fruit juice</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>e. Potato chips or other salty snack foods</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>f. Soft-drink or other sweetened drinks</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>g. Chocolate or other lollies</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
</tbody>
</table>

QB11  The statements below ask about your views on a number of things about/related to your baby's eating. (Please indicate how much you agree or disagree with the statements by shading one response for each statement.)

<table>
<thead>
<tr>
<th></th>
<th>Strongly Disagree</th>
<th>Disagree</th>
<th>Agree</th>
<th>Strongly Agree</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>a. It will be important that my baby learns to enjoy a wide range of fruits and vegetables</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>b. The foods I make available to my baby will affect what foods s/he comes to like</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>c. Babies are more likely to enjoy a food if they see their parents eating it</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>d. If I keep on offering foods my baby hasn't previously enjoyed s/he is likely to come to enjoy them</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>e. A good way to get my baby to eat healthy foods will be to offer a food treat as a reward (for example, offering dessert if s/he eats all their vegetables)</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>f. Babies usually don’t like vegetables</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>g. Babies usually won’t drink plain water</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
</tbody>
</table>
QB12  How confident are you that you will be able to do the following things with your baby over the next year? (Please shade one response for each statement.)

<table>
<thead>
<tr>
<th>Statement</th>
<th>Not at all confident</th>
<th>Slightly confident</th>
<th>Very confident</th>
<th>Extremely confident</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. Get my baby to eat enough vegetables (this does not include potato or potato chips) over the next year</td>
<td>O₁</td>
<td>O₂</td>
<td>O₃</td>
<td>O₄</td>
</tr>
<tr>
<td>b. Get my baby to drink plain water (with no flavours or juice added) over the next year</td>
<td>O₁</td>
<td>O₂</td>
<td>O₃</td>
<td>O₄</td>
</tr>
<tr>
<td>c. Get my baby to eat a good range of foods over the next year</td>
<td>O₁</td>
<td>O₂</td>
<td>O₃</td>
<td>O₄</td>
</tr>
<tr>
<td>d. Get my baby to eat enough fruit (this does not include fruit juice) over the next year</td>
<td>O₁</td>
<td>O₂</td>
<td>O₃</td>
<td>O₄</td>
</tr>
<tr>
<td>e. Say ‘no’ to my baby’s demands/fussing to watch TV/video/DVD over the next year</td>
<td>O₁</td>
<td>O₂</td>
<td>O₃</td>
<td>O₄</td>
</tr>
<tr>
<td>f. Provide my baby with a range of active play options over the next year</td>
<td>O₁</td>
<td>O₂</td>
<td>O₃</td>
<td>O₄</td>
</tr>
<tr>
<td>g. Keep my baby entertained without using TV/video/DVDs over the next year</td>
<td>O₁</td>
<td>O₂</td>
<td>O₃</td>
<td>O₄</td>
</tr>
<tr>
<td>h. Play with my baby</td>
<td>O₁</td>
<td>O₂</td>
<td>O₃</td>
<td>O₄</td>
</tr>
</tbody>
</table>

SECTION C: YOUR BABY’S ACTIVITIES

QC1  How much time does your child spend in sleep during the NIGHT (between 7 pm and 7 am)?

____________ hours & __________ minutes

QC2  How much time does your child spend in sleep during the DAY (between 7 am and 7 pm)?

____________ hours & __________ minutes

QC3  Thinking about the past month, how often did you or your partner do the following things? (Please shade one response for each statement.)

<table>
<thead>
<tr>
<th>Statement</th>
<th>Never or rarely</th>
<th>Some days each week</th>
<th>Most days each week</th>
<th>Every day</th>
<th>At least once a day</th>
<th>Several times each day</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. Put the TV, a video or DVD on for my/our baby to watch</td>
<td>O₁</td>
<td>O₂</td>
<td>O₃</td>
<td>O₄</td>
<td>O₅</td>
<td>O₆</td>
</tr>
<tr>
<td>b. Have the TV on in the same room when my/our baby was in a bouncer, stroller or highchair</td>
<td>O₁</td>
<td>O₂</td>
<td>O₃</td>
<td>O₄</td>
<td>O₅</td>
<td>O₆</td>
</tr>
<tr>
<td>c. Have the TV on during dinner</td>
<td>O₁</td>
<td>O₂</td>
<td>O₃</td>
<td>O₄</td>
<td>O₅</td>
<td>O₆</td>
</tr>
<tr>
<td>d. Take my/our baby for a walk in the pram/pusher</td>
<td>O₁</td>
<td>O₂</td>
<td>O₃</td>
<td>O₄</td>
<td>O₅</td>
<td>O₆</td>
</tr>
</tbody>
</table>
QC4  The following statements ask about your views regarding television for babies and toddlers (0-2 years of age). (Please indicate how much you agree or disagree with each statement by shading one response for each statement.)

<table>
<thead>
<tr>
<th></th>
<th>Strongly Disagree</th>
<th>Disagree</th>
<th>Agree</th>
<th>Strongly Agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. TV is educational</td>
<td>O_1</td>
<td>O_2</td>
<td>O_3</td>
<td>O_4</td>
</tr>
<tr>
<td>b. Babies and toddlers can learn from TV, videos and DVDs</td>
<td>O_1</td>
<td>O_2</td>
<td>O_3</td>
<td>O_4</td>
</tr>
<tr>
<td>c. Babies and toddlers should be allowed to watch TV</td>
<td>O_1</td>
<td>O_2</td>
<td>O_3</td>
<td>O_4</td>
</tr>
<tr>
<td>d. TV is helpful for a baby’s development (e.g. language skills)</td>
<td>O_1</td>
<td>O_2</td>
<td>O_3</td>
<td>O_4</td>
</tr>
<tr>
<td>e. TV is useful for keeping babies and toddlers occupied</td>
<td>O_1</td>
<td>O_2</td>
<td>O_3</td>
<td>O_4</td>
</tr>
</tbody>
</table>

QC5  The following statements ask about what you think will happen with your baby's play time in the coming months. (Please indicate how much you agree or disagree with the statements by shading one response for each statement.)

<table>
<thead>
<tr>
<th></th>
<th>Strongly Disagree</th>
<th>Disagree</th>
<th>Agree</th>
<th>Strongly Agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. I think I will take my baby for a walk every day</td>
<td>O_1</td>
<td>O_2</td>
<td>O_3</td>
<td>O_4</td>
</tr>
<tr>
<td>b. I think I will spend time each day playing active games with my baby (e.g. peek-a-boo, rolling a ball)</td>
<td>O_1</td>
<td>O_2</td>
<td>O_3</td>
<td>O_4</td>
</tr>
<tr>
<td>c. I think my baby will watch TV every day</td>
<td>O_1</td>
<td>O_2</td>
<td>O_3</td>
<td>O_4</td>
</tr>
<tr>
<td>d. I think my baby will spend many hours each day in a pusher, highchair, bouncer or playpen</td>
<td>O_1</td>
<td>O_2</td>
<td>O_3</td>
<td>O_4</td>
</tr>
<tr>
<td>e. I think I will use TV to distract my baby when s/he is being difficult</td>
<td>O_1</td>
<td>O_2</td>
<td>O_3</td>
<td>O_4</td>
</tr>
<tr>
<td>f. I think I will use TV to keep my baby occupied so that I can get things done</td>
<td>O_1</td>
<td>O_2</td>
<td>O_3</td>
<td>O_4</td>
</tr>
<tr>
<td>g. I think that when s/he is older, my baby will have similar physical activity levels to my own</td>
<td>O_1</td>
<td>O_2</td>
<td>O_3</td>
<td>O_4</td>
</tr>
<tr>
<td>h. I think that when s/he is older, my baby will watch similar amounts of TV to me</td>
<td>O_1</td>
<td>O_2</td>
<td>O_3</td>
<td>O_4</td>
</tr>
</tbody>
</table>
SECTION D: ABOUT YOU

QD1 What is your date of birth? (Please write on the line)

______/______/19___ (dd/mm/19yy)

QD2 How would you rate your health? (Please shade one response only.)

<table>
<thead>
<tr>
<th>Poor</th>
<th>Fair</th>
<th>Good</th>
<th>Very good</th>
<th>Excellent</th>
</tr>
</thead>
<tbody>
<tr>
<td>⃝ 1</td>
<td>⃝ 2</td>
<td>⃝ 3</td>
<td>⃝ 4</td>
<td>⃝ 5</td>
</tr>
</tbody>
</table>

QD3 How would you rate your own sleep over the past week? (Please shade one response only)

<table>
<thead>
<tr>
<th>Very bad</th>
<th>Fairly bad</th>
<th>Fairly good</th>
<th>Very good</th>
</tr>
</thead>
<tbody>
<tr>
<td>⃝ 1</td>
<td>⃝ 2</td>
<td>⃝ 3</td>
<td>⃝ 4</td>
</tr>
</tbody>
</table>

QD4 How much attention do you usually pay to: (Please shade one response on each line.)

<table>
<thead>
<tr>
<th></th>
<th>None</th>
<th>A little</th>
<th>Some</th>
<th>Much</th>
<th>Very much</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. Your personal health habits?</td>
<td>⃝ 1</td>
<td>⃝ 2</td>
<td>⃝ 3</td>
<td>⃝ 4</td>
<td>⃝ 5</td>
</tr>
<tr>
<td>b. Getting enough physical activity?</td>
<td>⃝ 1</td>
<td>⃝ 2</td>
<td>⃝ 3</td>
<td>⃝ 4</td>
<td>⃝ 5</td>
</tr>
<tr>
<td>c. Eating a healthy low-fat diet?</td>
<td>⃝ 1</td>
<td>⃝ 2</td>
<td>⃝ 3</td>
<td>⃝ 4</td>
<td>⃝ 5</td>
</tr>
<tr>
<td>d. Controlling your weight?</td>
<td>⃝ 1</td>
<td>⃝ 2</td>
<td>⃝ 3</td>
<td>⃝ 4</td>
<td>⃝ 5</td>
</tr>
</tbody>
</table>

QD5 Which of the following best describes your current smoking status? (Please shade one response only.)

<table>
<thead>
<tr>
<th>I have never smoked</th>
<th>I used to smoke</th>
<th>I now smoke occasionally</th>
<th>I now smoke regularly</th>
</tr>
</thead>
<tbody>
<tr>
<td>⃝ 1</td>
<td>⃝ 2</td>
<td>⃝ 3</td>
<td>⃝ 4</td>
</tr>
</tbody>
</table>

QD6 Are you currently on a diet to lose weight or control your weight? (Please shade one response only.)

<table>
<thead>
<tr>
<th>Yes to lose weight</th>
<th>Yes to gain weight</th>
<th>Yes to avoid weight gain</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>⃝ 1</td>
<td>⃝ 2</td>
<td>⃝ 3</td>
<td>⃝ 4</td>
</tr>
</tbody>
</table>
**QD7** In which country were you born? (Please shade one response only.)

<table>
<thead>
<tr>
<th>Question</th>
<th>Australia</th>
<th>UK</th>
<th>Italy</th>
<th>Greece</th>
<th>New Zealand</th>
<th>Vietnam</th>
<th>Other</th>
</tr>
</thead>
<tbody>
<tr>
<td>Response</td>
<td>○₁</td>
<td>○₂</td>
<td>○₃</td>
<td>○₄</td>
<td>○₅</td>
<td>○₆</td>
<td>○₇</td>
</tr>
</tbody>
</table>

**QD8** Which of the following best describes your current relationship status? (Please shade one response only.)

<table>
<thead>
<tr>
<th>Relationship Status</th>
<th>Living in a registered marriage</th>
<th>Living in a defacto relationship</th>
<th>Separated</th>
<th>Divorced</th>
<th>Widowed</th>
<th>Never married</th>
</tr>
</thead>
<tbody>
<tr>
<td>Response</td>
<td>○₁</td>
<td>○₂</td>
<td>○₃</td>
<td>○₄</td>
<td>○₅</td>
<td>○₆</td>
</tr>
</tbody>
</table>

**QD9** What is the HIGHEST qualification you, and your spouse/partner, have completed? (Please shade one response on each line: one for you, and one for your spouse/partner. If you do not have a spouse/partner please shade that response below.)

<table>
<thead>
<tr>
<th>Qualification Level</th>
<th>Self</th>
<th>Spouse/Partner</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. High 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>○₇</td>
</tr>
<tr>
<td>I do not have a spouse/partner</td>
<td>○₈</td>
<td>○₈</td>
</tr>
</tbody>
</table>

**QD10** Which of the following BEST describes your current MAIN DAILY activities and/or responsibilities, and those of your spouse/partner? (Please shade one response on each line: one for you, and one for your spouse/partner. If you do not have a spouse/partner please shade that response below.)

<table>
<thead>
<tr>
<th>Activity</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>○₇</td>
</tr>
</tbody>
</table>
**QD11** During the *last month*,

a) Approximately how many *days* did you work in paid employment?
   
   ________ days per week  OR  ____________ total days in the last month

b) How many *hours* did you work on an average day?
   
   _____  hours per day

The following questions ask about your use of internet and Facebook.

**QD12** Do you use the internet? (Please shade one response only.)

<table>
<thead>
<tr>
<th></th>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
<td>2</td>
</tr>
</tbody>
</table>

Go to Question D17

**QD13** Do you use the internet to access information on the following topics? (Please shade one response on each line.)

<table>
<thead>
<tr>
<th>Topic or Area</th>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. Your health</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>b. Dieting</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>c. Your baby's health</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>d. How to feed your baby</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>e. How to play with your baby</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>f. Recipes</td>
<td>1</td>
<td>2</td>
</tr>
</tbody>
</table>

**QD14** Are you a member of Facebook? (Please shade one response only.)

<table>
<thead>
<tr>
<th></th>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
<td>2</td>
</tr>
</tbody>
</table>

Go to Question D17

**QD15** On average how often would you log in to Facebook? (Please shade one response only.)

<table>
<thead>
<tr>
<th>Frequency</th>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>Once a week or less</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>A few times/week</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Once daily</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>A few times/day</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Several times/day</td>
<td>5</td>
<td></td>
</tr>
</tbody>
</table>

**QD16** Could you imagine using Facebook to connect with other new mothers? (Please shade one response only.)

<table>
<thead>
<tr>
<th></th>
<th>Yes</th>
<th>No</th>
<th>Maybe</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
</tbody>
</table>
The following question asks about your income. This is an important question because income can be related to people's eating, physical activity and health.

QD17 What is the average gross (before tax) income that you and your household receive each **WEEK**, including wages, salary, pensions and allowances? (Please shade one response in each column: one for yourself and one for your household.)

<table>
<thead>
<tr>
<th></th>
<th>Self</th>
<th>Household</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. No income</td>
<td>O1</td>
<td>O1</td>
</tr>
<tr>
<td>b. $1-$119 per week ($1-$6,239 annually)</td>
<td>O2</td>
<td>O2</td>
</tr>
<tr>
<td>c. $120-$299 per week ($6,240-$15,999 annually)</td>
<td>O3</td>
<td>O3</td>
</tr>
<tr>
<td>d. $300-$599 per week ($16,000-$31,999 annually)</td>
<td>O4</td>
<td>O4</td>
</tr>
<tr>
<td>e. $600-$799 per week ($32,000-$41,999 annually)</td>
<td>O5</td>
<td>O5</td>
</tr>
<tr>
<td>f. $800-$999 per week ($42,000-$51,999 annually)</td>
<td>O6</td>
<td>O6</td>
</tr>
<tr>
<td>g. $1,000-$1,499 per week ($52,000-$77,999 annually)</td>
<td>O7</td>
<td>O7</td>
</tr>
<tr>
<td>h. $1,500-$1,999 per week ($78,000-$99,999 annually)</td>
<td>O8</td>
<td>O8</td>
</tr>
<tr>
<td>i. $2,000 or more per week ($100,000 or more annually)</td>
<td>O9</td>
<td>O9</td>
</tr>
<tr>
<td>j. Don’t know</td>
<td>O99</td>
<td>O99</td>
</tr>
<tr>
<td>k. Don’t want to answer</td>
<td>O98</td>
<td>O98</td>
</tr>
<tr>
<td>l. Household income is the same as mine</td>
<td>O97</td>
<td></td>
</tr>
</tbody>
</table>

QD18 Do you have a Health Care Card (from CentreLink)? (Please shade one response only)

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>O1</td>
</tr>
<tr>
<td>No</td>
<td>O2</td>
</tr>
</tbody>
</table>

Well done – you are more than half way through the survey!

You might like to take a break and complete the remainder over a cup of tea.
SECTION E: ABOUT YOUR PREGNANCY

These questions ask about the time just before your pregnancy.

QE1  Before you were pregnant with this baby, how much did you weigh without shoes? (If unsure, please give your best guess.)

_____ kg  OR  _____ stone/pounds

QE2  Before you were pregnant with this baby, did a doctor, nurse, or other health care worker talk with you about any of the things listed below? (Please shade one response in each row.)

<table>
<thead>
<tr>
<th></th>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. Taking vitamins with folic acid before pregnancy</td>
<td>O₁</td>
<td>O₂</td>
</tr>
<tr>
<td>b. Taking Iodine supplements before pregnancy</td>
<td>O₁</td>
<td>O₂</td>
</tr>
<tr>
<td>c. Being a healthy weight before pregnancy</td>
<td>O₁</td>
<td>O₂</td>
</tr>
<tr>
<td>d. Eating a healthy diet during pregnancy</td>
<td>O₁</td>
<td>O₂</td>
</tr>
<tr>
<td>e. Being physically active during pregnancy</td>
<td>O₁</td>
<td>O₂</td>
</tr>
<tr>
<td>f. Avoiding smoking during pregnancy</td>
<td>O₁</td>
<td>O₂</td>
</tr>
<tr>
<td>g. Avoiding drinking alcohol during pregnancy</td>
<td>O₁</td>
<td>O₂</td>
</tr>
<tr>
<td>h. Avoiding using illegal drugs during pregnancy</td>
<td>O₁</td>
<td>O₂</td>
</tr>
</tbody>
</table>

These questions ask about what happened during your pregnancy.

QE3  During your pregnancy with this baby, did a doctor, nurse, or other health care worker talk with you about any of the things listed below? (Please shade one response in each row.)

<table>
<thead>
<tr>
<th></th>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. How much weight you should gain during pregnancy</td>
<td>O₁</td>
<td>O₂</td>
</tr>
<tr>
<td>b. Eating a healthy diet during pregnancy</td>
<td>O₁</td>
<td>O₂</td>
</tr>
<tr>
<td>c. Being physically active during pregnancy</td>
<td>O₁</td>
<td>O₂</td>
</tr>
<tr>
<td>d. Planning to breastfeed your baby</td>
<td>O₁</td>
<td>O₂</td>
</tr>
<tr>
<td>e. Avoiding gaining too much weight during pregnancy</td>
<td>O₁</td>
<td>O₂</td>
</tr>
<tr>
<td>f. Avoiding smoking during pregnancy</td>
<td>O₁</td>
<td>O₂</td>
</tr>
<tr>
<td>g. Avoiding drinking alcohol during pregnancy</td>
<td>O₁</td>
<td>O₂</td>
</tr>
<tr>
<td>h. Avoiding using illegal drugs during pregnancy</td>
<td>O₁</td>
<td>O₂</td>
</tr>
</tbody>
</table>
QE4  How often were you weighed over the course of your pregnancy by any of the following practitioners? (Please shade one response in each row.)

<table>
<thead>
<tr>
<th>Never</th>
<th>Once</th>
<th>2 or 3 times</th>
<th>4 to 7 times</th>
<th>Monthly</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. Midwife</td>
<td>O1</td>
<td>O2</td>
<td>O3</td>
<td>O4</td>
</tr>
<tr>
<td>b. Obstetrician</td>
<td>O1</td>
<td>O2</td>
<td>O3</td>
<td>O4</td>
</tr>
<tr>
<td>c. Dietitian</td>
<td>O1</td>
<td>O2</td>
<td>O3</td>
<td>O4</td>
</tr>
<tr>
<td>d. General Practitioner</td>
<td>O1</td>
<td>O2</td>
<td>O3</td>
<td>O4</td>
</tr>
<tr>
<td>e. Other</td>
<td>Please specify</td>
<td>O1</td>
<td>O2</td>
<td>O3</td>
</tr>
</tbody>
</table>

QE5  How often did you weigh yourself throughout the course of your pregnancy? (Please shade one response only.)

<table>
<thead>
<tr>
<th>Never</th>
<th>Once or twice</th>
<th>4 or 5 times</th>
<th>Monthly</th>
<th>Weekly</th>
<th>More than once a week</th>
</tr>
</thead>
<tbody>
<tr>
<td>O1</td>
<td>O2</td>
<td>O3</td>
<td>O4</td>
<td>O5</td>
<td>O6</td>
</tr>
</tbody>
</table>

QE6  During your pregnancy, did you undertake physical activity in your leisure-time which made you breathe harder for at least 150 minutes a week? For example 30 minutes a day, 5 days a week. (Includes brisk walking, swimming, jogging, dancing etc.)

Yes – in **every trimester** O1  Go to QE8

Yes – but **not in every trimester**
(Please indicate which trimester/s you were active)

| O2 | Trimester 1/Trimester 2/Trimester 3 |
| Now Go to QE8 |

No O3  Go to QE 7

QE7  If you answered no, please tell us why you didn’t undertake leisure-time activity that made you breathe harder over this time.
QE8  Did you smoke during your pregnancy? (Please shade one response only)

Yes, every day. On average I smoked ___ cigarettes / day  O₁
Yes, but occasionally (less than 1 cigarette/day)  O₂
No, I did not smoke during my pregnancy  O₃

These questions ask about what happened after your pregnancy.

QE9  Since you delivered this baby, has a doctor, nurse, or other health care worker talked with you about any of the things listed below? (Please shade one response in each row.)

<table>
<thead>
<tr>
<th></th>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. How much you should now weigh</td>
<td>O₁</td>
<td>O₂</td>
</tr>
<tr>
<td>b. Programs or resources to help you lose weight after pregnancy</td>
<td>O₁</td>
<td>O₂</td>
</tr>
<tr>
<td>c. Eating a healthy diet</td>
<td>O₁</td>
<td>O₂</td>
</tr>
<tr>
<td>d. Being physically active</td>
<td>O₁</td>
<td>O₂</td>
</tr>
<tr>
<td>e. How long to breastfeed your baby</td>
<td>O₁</td>
<td>O₂</td>
</tr>
</tbody>
</table>

QE10  How much weight did you gain during your pregnancy? (If unsure, please give your best guess.)

_____ kg  OR  _____ stone/pounds

QE11  At full term – that is at the end of your pregnancy, but before you’d delivered, how much did you weigh without shoes? (If unsure, please give your best guess.)

_____ kg OR _____ stone/pounds

SECTION F: YOUR OWN ACTIVITIES

QF1  On a usual weekday (Monday through to Friday), about how many hours do you usually spend sitting down and watching television or videos/DVDs? (In hours and/or minutes)

_______ hours and _______ minutes each weekday

QF2  On a usual weekend day (Saturday or Sunday), about how many hours do you usually spend sitting down and watching television or videos/DVDs? (In hours and/or minutes)

_______ hours and _______ minutes each weekend
In the following section we want you to think about the physical activities that you have done in the last week.

**QF3** In the *last week*, how many times have you walked continuously, for at least 10 minutes, for recreation, exercise or to get to or from places?

___ times

**QF4** What do you estimate was the total time that you spent walking in this way in the *last week*?  
(In hours and/or minutes)

_______ hours and ______ minutes

**QF5** In the *last week*, how many times did you do any vigorous gardening or heavy work around the yard, which made you breathe harder or puff and pant?

___ times

**QF6** What do you estimate was the total time that you spent doing vigorous gardening or heavy work around the yard in the *last week*?  
(In hours and/or minutes)

_______ hours and ______ minutes

The next questions exclude household chores, gardening or yard work.

**QF7** In the *last week*, how many times did you do any vigorous physical activity which made you breathe harder or puff and pant? (e.g. jogging, cycling, aerobics, competitive tennis)

___ times

**QF8** What do you estimate was the total time that you spent doing this vigorous physical activity in the *last week*? (In hours and/or minutes)

_______ hours and ______ minutes

**QF9** In the *last week*, how many times did you do any other more moderate physical activities that you have not already mentioned? (e.g. gentle swimming, social tennis, golf)

___ times

**QF10** What do you estimate was the total time that you spent doing these activities in the *last week*? (In hours and/or minutes)

_______ hours and ______ minutes

You are on the home stretch now! 😊

Just a few more questions
The next questions ask about a healthy diet. By this we mean a diet that includes a lot of fruit and vegetables, and doesn’t contain a lot of fat.

**QG1** How confident are you that you could do the following over the next year? (Please shade one response on each line.)

- a. Shop regularly for healthy nutritious foods
- b. Prepare/cook healthy nutritious foods
- c. Stick to eating healthy nutritious foods
- d. Eat enough fruit for good health
- e. Eat enough vegetables for good health
- f. Limit your fast food consumption to once a week or less
- g. Eat a low-fat diet
- h. Stick to low-fat healthy foods even when you feel depressed, bored or tense
- i. Stick to low-fat healthy foods when you are eating out
- j. Stick to low-fat healthy foods when you are eating at work/place of study
- k. Stick to low-fat healthy foods even when there are high-fat foods available
- l. Stick to low-fat healthy foods even when eating with friends or co-workers
- m. Stick to low-fat healthy foods even when you are alone and there is no one to watch you
- n. Stick to low-fat healthy foods even when you feel too tired or lazy to prepare something healthy
- o. Stick to low-fat healthy foods even when you are craving less healthy foods
How confident are you that you could do physical activity, in each of the following situations, over the next year? (Please shade one response on each line).

<table>
<thead>
<tr>
<th>QG2</th>
<th>Question</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>Do physical activity when I am tired</td>
<td>01</td>
<td>02</td>
<td>03</td>
<td>04</td>
<td>05</td>
</tr>
<tr>
<td>b.</td>
<td>Do physical activity when I am in a bad mood</td>
<td>01</td>
<td>02</td>
<td>03</td>
<td>04</td>
<td>05</td>
</tr>
<tr>
<td>c.</td>
<td>Do physical activity when I don’t have time</td>
<td>01</td>
<td>02</td>
<td>03</td>
<td>04</td>
<td>05</td>
</tr>
<tr>
<td>d.</td>
<td>Do physical activity when I am on holiday</td>
<td>01</td>
<td>02</td>
<td>03</td>
<td>04</td>
<td>05</td>
</tr>
<tr>
<td>e.</td>
<td>Do physical activity when it is raining</td>
<td>01</td>
<td>02</td>
<td>03</td>
<td>04</td>
<td>05</td>
</tr>
</tbody>
</table>

The next questions are about how you’ve been feeling in the past week.

Below is a list of some of the ways you may have felt or behaved. How often have you felt this way during the past week? (Please shade one response on each line)

<table>
<thead>
<tr>
<th>QG3</th>
<th>Question</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>a.</td>
<td>I was bothered by things that usually don’t bother me</td>
<td>01</td>
<td>02</td>
<td>03</td>
<td>04</td>
</tr>
<tr>
<td>b.</td>
<td>I had trouble keeping my mind on what I was doing</td>
<td>01</td>
<td>02</td>
<td>03</td>
<td>04</td>
</tr>
<tr>
<td>c.</td>
<td>I felt depressed</td>
<td>01</td>
<td>02</td>
<td>03</td>
<td>04</td>
</tr>
<tr>
<td>d.</td>
<td>I felt that everything I did was an effort</td>
<td>01</td>
<td>02</td>
<td>03</td>
<td>04</td>
</tr>
<tr>
<td>e.</td>
<td>I felt hopeful about the future</td>
<td>01</td>
<td>02</td>
<td>03</td>
<td>04</td>
</tr>
<tr>
<td>f.</td>
<td>I felt fearful</td>
<td>01</td>
<td>02</td>
<td>03</td>
<td>04</td>
</tr>
<tr>
<td>g.</td>
<td>My sleep was restless</td>
<td>01</td>
<td>02</td>
<td>03</td>
<td>04</td>
</tr>
<tr>
<td>h.</td>
<td>I was happy</td>
<td>01</td>
<td>02</td>
<td>03</td>
<td>04</td>
</tr>
<tr>
<td>i.</td>
<td>I felt lonely</td>
<td>01</td>
<td>02</td>
<td>03</td>
<td>04</td>
</tr>
<tr>
<td>j.</td>
<td>I could not “get going”</td>
<td>01</td>
<td>02</td>
<td>03</td>
<td>04</td>
</tr>
</tbody>
</table>
SECTION H: YOUR ADVICE FROM HEALTH CARERS

These questions ask about your use of health carers since you had your baby.

QH1  Have you attended any extra appointments, with your Maternal and Child Health Nurse specifically to discuss concerns you had about your child's weight, diet, feeding or activity?
Note: this means in addition to the standard visits set out in your blue book.

<table>
<thead>
<tr>
<th>Yes</th>
<th>Number of visits you have had: __________</th>
</tr>
</thead>
<tbody>
<tr>
<td>No</td>
<td></td>
</tr>
</tbody>
</table>

QH2  Since the birth of your baby have you looked for help and/or advice about concerns you had about your child's or your own weight, diet or activity?

<table>
<thead>
<tr>
<th>Yes</th>
<th>Go to Question H3</th>
</tr>
</thead>
<tbody>
<tr>
<td>No</td>
<td>You have finished the survey!</td>
</tr>
</tbody>
</table>

QH3  If yes, where did you get your help/advice from? Please indicate where appropriate, how many visits you attended and how much you had to pay for a visit (if anything).

<table>
<thead>
<tr>
<th>How many?</th>
<th>Total cost</th>
<th>Cost to you</th>
</tr>
</thead>
<tbody>
<tr>
<td>a.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Maternal Health Nurse helpline or other telephone helpline</td>
<td>_____ calls</td>
</tr>
<tr>
<td>b.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Mother-baby / parenting centre (day stay only)</td>
<td>_____ visits</td>
</tr>
<tr>
<td>c.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Mother-baby / parenting centre (overnight stay)</td>
<td>_____ days</td>
</tr>
<tr>
<td>d.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Home visiting or outreach nurse</td>
<td>_____ visits</td>
</tr>
<tr>
<td>e.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>GP (family doctor)</td>
<td>_____ visits</td>
</tr>
<tr>
<td>f.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Paediatrician</td>
<td>_____ visits</td>
</tr>
<tr>
<td>g.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Dietitian</td>
<td>_____ visits</td>
</tr>
<tr>
<td>h.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Chiropractor / Osteopath or Naturopath</td>
<td>_____ visits</td>
</tr>
<tr>
<td>i.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Other health professional, please describe</td>
<td>_____ visits</td>
</tr>
</tbody>
</table>

Thank you for finishing this survey. We sincerely appreciate that this has taken lots of time and effort.
Please bring this survey to the next session.
Appendix 4
The Cancer Council Victoria (CCV)
Dietary Questionnaire for Epidemiological Studies (DQES)
Food Frequency Questionnaire
Dietary Questionnaire for Epidemiological Studies (DQES)
Version 3.1

PLEASE READ THE FOLLOWING INSTRUCTIONS CAREFULLY

- Please use a soft pencil, preferably 2B or black/blue biro, not felt tip pen
- Please do not staple or make holes of any kind
- Please avoid folding or bending this form
- Please make no stray marks
- If you make a mistake, either erase or place a cross through the incorrect oval and fill in the correct oval

1. This questionnaire is about your usual eating and drinking habits over the last 12 months. Please include what you ate for breakfast, lunch and dinner, and for snacks between meals, including meals you ate at home and meals you ate elsewhere.

2. Every question must be answered. If you are not sure of the answer an estimate is required.

Questions about YOUR HOUSEHOLD

1. How many people, including you, live in your household?
   - I live alone (GO TO QUESTION 3)  
   - 2  
   - 3  
   - 4  
   - 5  
   - 6  
   - 7 or more

2. How much of the weekly planning and preparing of meals do you do for your household?
   - All or almost all  
   - About 3/4  
   - About 1/2  
   - About 1/4  
   - None or almost none

3. How much olive oil is used per month in your household?
   - NONE  
   - About 1/2 a litre or less per month  
   - About 3/4 of a litre (750 ml)  
   - About 1 litre  
   - About 1 1/2 litres  
   - About 2 litres  
   - About 3 litres  
   - About 4 litres  
   - More than 4 litres per month

4. How much canola oil is used per month in your household?
   - NONE  
   - About 1/2 a litre or less per month  
   - About 3/4 of a litre (750 ml)  
   - About 1 litre  
   - About 1 1/2 litres  
   - About 2 litres  
   - About 3 litres  
   - About 4 litres  
   - More than 4 litres per month
5. How much other vegetable oil is used per month in your household? Other vegetable oils include blended vegetable oil, sesame oil, peanut oil, sunflower oil, etc.

- None
  - About 1/2 a litre or less per month
  - About 3/4 of a litre (750 ml)
  - About 1 litre
  - About 1 1/2 litres

6. In the last 12 months, what types of margarine did you usually use? Please mark all types that you used.

- None
  - Canola margarine
  - Margarine to lower cholesterol
  - Miracle/Miracle spread
  - Olive oil margarine
  - Nuttelex
  - Polyunsaturated margarine
  - Soy margarine
  - Sterol margarine (Pro-activ or Logicol)
  - Weight Watchers margarine

7. In the last 12 months, how much milk did you usually use per day? Please include milk drunk on its own, flavoured milk, soy milk and milk or soy milk added to cereal or to beverages such as tea, coffee, café latte and drinking chocolate.

- None (go to question 9)
  - Less than 1/2 a cup per day (less than 125 mL)
  - About 1/2 a cup per day (125 mL)
  - About 1 cup per day (250 mL)
  - About 2 cups per day (500 mL)
  - 3 or more cups per day (750 mL or more)

8. What types of milk did you usually use? Please mark all types used.

- Full cream
- Reduced fat milk 1-3% fat (Anything with "low fat" in title e.g. REV, Light Start, Devondale Smart milk)
- Skim milk less than 1% fat (Anything with "skim" or "no fat" in title e.g. Weight Watchers, Skinny milk)
- Soy milk
- Flavoured milk (Milkshakes, Rice milk, Coconut milk)

9. The next two questions are about carbonated soft drinks. These include Coca-Cola, Pepsi, Solo, lemonade and flavoured mineral water, but not unflavoured mineral water or soda water.

When answering the questions, please convert the amounts you drank into glasses using the examples given below.

375 mL can = 2 glasses
750 mL bottle = 4 glasses
1.25 litre bottle = 7 glasses
1.5 litre bottle = 8 glasses
2 litre bottle = 11 glasses

In the last 12 months, how many glasses of diet soft drink, such as Diet Coke, did you drink per day?

- None
- Less than 1 glass per day
- 1 glass
- 2 glasses (or 1 can)
- 3 glasses
- 4 glasses
- 5 glasses
- 6 glasses
- 7 glasses
- 8 glasses
- 9 glasses
- 10 or more glasses

10. In the last 12 months, how many glasses of regular soft drink did you drink per day?

- None
- Less than 1 glass per day
- 1 glass
- 2 glasses (or 1 can)
- 3 glasses
- 4 glasses
- 5 glasses
- 6 glasses
- 7 glasses
- 8 glasses
- 9 glasses
- 10 or more glasses
11 In the last 12 months, how many slices of bread did you usually eat per day? Please include all types of bread, fresh or toasted. Count one bread roll as 2 slices.

NONE (GO TO QUESTION 14) ①
Less than 1 slice per day ②
1 slice per day ③
2 slices per day ③
3 slices per day ③
4 slices per day ③
5 to 7 slices per day ③
8 or more slices per day ⑥

12 What types of bread and rolls did you usually eat? Please mark all types used.

White (include Turkish) ①
High fibre white ③
Wholemeal ③
Multi-grain ③
Rye (include rye sourdough) ⑥
Soy and linseed ⑥

13 What type of spread or oil did you usually put on your bread?

NONE ①
Becel ③
Butter ③
Logicol ③
Margarine ③
Nuttelex ⑥
Olive Grove ③
Olive oil ③
Olive oil spread ③
Omega/hi omega ③
Pro Activ ③
Soy ③
Sterol ③

14 In the last 12 months, how many eggs did you usually eat per week? Please include eggs that are fried, boiled, scrambled, poached or used in omelettes.

NONE ①
Less than 1 egg per week ②
1 to 2 eggs per week ③
3 to 5 eggs per week ⑤
6 or more eggs per week ⑥

15 In the last 12 months, how many serves of fruit did you usually eat per day?

Please count 1 serve as either –
- a whole piece of fruit such as an apple, pear or banana
- a handful of fruit such as apricots, grapes, berries or raisins
- 1 cup of chopped fruit, fruit salad or stewed fruit

NONE ①
Less than 1 serve of fruit per day ②
1 serve of fruit per day ③
2 serves per day ③
3 serves per day ③
4 serves per day ③
5 serves per day ③
6 or more serves of fruit per day ⑥

16 In the last 12 months, how many serves of vegetables, including potatoes, did you usually eat per day?

Please count 1 serve as either -
- 1 cup of salad vegetables or
- 1/2 cup of cooked vegetables

NONE ①
Less than 1 serve of vegetables per day ②
1 serve of vegetables per day ③
2 serves per day ③
3 serves per day ③
4 serves per day ③
5 serves per day ③
6 serves per day ③
7 or more serves of vegetables per day ⑥

11855
For the next few questions we want you to look at some pictures of different foods. When you look at the pictures, think about how much you usually ate at main meals, such as lunch or dinner. If you usually ate more than one helping, think about the picture that is closest to the total amount you ate.

17. When you ate rice in the last 12 months, how much did you usually eat?
   ○ I did not eat rice
   ○ Less than A
   ○ Between A & B
   ○ Between B & C
   ○ More than C

18. When you ate fish in the last 12 months, how much did you usually eat?
   ○ I did not eat fish
   ○ Less than A
   ○ Between A & B
   ○ Between B & C
   ○ More than C

19. When you ate steak in the last 12 months, how much did you usually eat?
   ○ I did not eat steak
   ○ Less than A
   ○ Between A & B
   ○ Between B & C
   ○ More than C
20. When you ate potato in the last 12 months, how much did you usually eat?
   - I did not eat potato
   - Less than A
   - Between A & B
   - Between B & C
   - More than C

21. When you ate salad in the last 12 months, how much did you usually eat?
   - I did not eat salad
   - Less than A
   - Between A & B
   - Between B & C
   - More than C

22. When you ate cooked vegetables in the last 12 months, how much did you usually eat?
   If you did not eat broccoli, peas or carrots please use these pictures to estimate the amount of any types of cooked vegetables that you usually ate.
   - I did not eat cooked vegetables
   - Less than A
   - Between A & B
   - Between B & C
   - More than C
In the last 12 months did you eat breakfast cereal other than porridge at least once per month?

- Yes
- No (GO TO QUESTION 25)

In the last 12 months which two breakfast cereals (other than porridge) did you eat most often? In column A, please mark the two types you ate most often, then mark the amount of the time you ate that cereal in column B. The total should be less than or equal to one.

<table>
<thead>
<tr>
<th>How often: Remember to fill in only two cereals</th>
<th>A Breakfast cereals ate most often (other than porridge)</th>
<th>B Amount of the time per year you ate that cereal</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Select up to 2 ONLY</td>
<td>1/4</td>
</tr>
<tr>
<td>All-Bran</td>
<td>1</td>
<td>☐</td>
</tr>
<tr>
<td>Bran or hi fibre cereal</td>
<td>2</td>
<td>☐</td>
</tr>
<tr>
<td>Corn flakes</td>
<td>3</td>
<td>☐</td>
</tr>
<tr>
<td>Fibre Plus</td>
<td>4</td>
<td>☐</td>
</tr>
<tr>
<td>HEALTH WISE (any variety)</td>
<td>5</td>
<td>☐</td>
</tr>
<tr>
<td>Just Right</td>
<td>6</td>
<td>☐</td>
</tr>
<tr>
<td>Muesli non-toasted or unknown Commercial</td>
<td>7</td>
<td>☐</td>
</tr>
<tr>
<td>Muesli non-toasted or unknown Homemade</td>
<td>8</td>
<td>☐</td>
</tr>
<tr>
<td>Muesli toasted Homemade or Commercial</td>
<td>9</td>
<td>☐</td>
</tr>
<tr>
<td>Nutri Grain</td>
<td>10</td>
<td>☐</td>
</tr>
<tr>
<td>Rice Bubbles/puffed rice</td>
<td>11</td>
<td>☐</td>
</tr>
<tr>
<td>Sultana Bran</td>
<td>12</td>
<td>☐</td>
</tr>
<tr>
<td>Special K</td>
<td>13</td>
<td>☐</td>
</tr>
<tr>
<td>Sustain</td>
<td>14</td>
<td>☐</td>
</tr>
<tr>
<td>Sports Plus</td>
<td>15</td>
<td>☐</td>
</tr>
<tr>
<td>Vita Brits</td>
<td>16</td>
<td>☐</td>
</tr>
<tr>
<td>Weet Bix regular</td>
<td>17</td>
<td>☐</td>
</tr>
<tr>
<td>Weet Bix other</td>
<td>18</td>
<td>☐</td>
</tr>
<tr>
<td>Weeties (including fruit and nut Weeties)</td>
<td>19</td>
<td>☐</td>
</tr>
</tbody>
</table>
### Dietary Questionnaire for Epidemiological Studies

**Over the last 12 months, how often did you usually eat each of the following foods?**

<table>
<thead>
<tr>
<th><strong>Times you have eaten:</strong></th>
<th>NEVER</th>
<th>Less than once per month</th>
<th>1-3 times per month</th>
<th>1 time per week</th>
<th>2 times per week</th>
<th>3-4 times per week</th>
<th>5-6 times per week</th>
<th>1 time per day</th>
<th>2 times per day</th>
<th>3 or more times per day</th>
</tr>
</thead>
</table>

#### A. Cereal-based Foods

- **Porridge, in winter**
- **Porridge, rest of the year**
- **Breakfast cereal other than porridge, in winter**
- **Breakfast cereal other than porridge, rest of the year**
- **Rice**
- **Pasta or noodles**
- **Wholemeal crackers or wholemeal dry biscuits**
- **Crackers or dry biscuits other than wholemeal**
- **Sweet biscuits**
- **Cakes or sweet pastries**

#### B. Dairy Foods and Fats

- **Margarine on cooked vegetables**
- **Butter/dairy blend on cooked vegetables**
- **Oil on cooked vegetables**
- **Low calorie, low fat salad dressing**
- **Mayonnaise**
- **Oil and vinegar salad dressing**
- **Ricotta or cottage cheese**
- **All other cheeses**
- **Cream or sour cream**
- **Ice-cream**
- **Yogurt**

#### C. Meat

**Fresh Meat:** The following meats are usually bought from the butcher or the butcher section of the supermarket.

- **Beef or veal (not corned)**
- **Chicken**
- **Lamb**
- **Pork (not corned or pickled)**
- **Sausages**

**Other Meat:** The following meats are usually bought from a delicatessen or the deli section of the supermarket.

- **Processed meat (e.g. ham, corned beef, prosciutto, salami)**
- **Bacon**

#### D. Fish

- **Fried fish**
- **Steamed, grilled or baked fish**
- **Tinned fish**
### E. FRUIT

**Seasonal fruits:** For the following fruits please indicate how often you usually ate them fresh when that fruit was in season.

<table>
<thead>
<tr>
<th>Fruit Description</th>
<th>Code</th>
<th>1-3 times per month</th>
<th>1 time per week</th>
<th>2 times per week</th>
<th>3-4 times per week</th>
<th>5-6 times per week</th>
<th>1 time per day</th>
<th>2 times per day</th>
<th>3 or more times per day</th>
</tr>
</thead>
<tbody>
<tr>
<td>Apricots (count 1 handful as 1 time)</td>
<td>E1</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Berries not including strawberries (count 1 handful as 1 time)</td>
<td>E2</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Cherries (count 1 handful as 1 time)</td>
<td>E3</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Figs (count 1 handful as 1 time)</td>
<td>E4</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Plums (count 1 handful as 1 time)</td>
<td>E5</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Mango or paw paw</td>
<td>E6</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Grapes (count 1 handful as 1 time)</td>
<td>E7</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Peaches or nectarines</td>
<td>E8</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
</tbody>
</table>

**Other fruit:** The following fruits are generally available year round.

<table>
<thead>
<tr>
<th>Fruit Description</th>
<th>Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>Apples</td>
<td>E9</td>
</tr>
<tr>
<td>Bananas</td>
<td>E10</td>
</tr>
<tr>
<td>Orange juice</td>
<td>E11</td>
</tr>
<tr>
<td>Other fruit juice</td>
<td>E12</td>
</tr>
<tr>
<td>Oranges or other citrus fruit</td>
<td>E13</td>
</tr>
<tr>
<td>Pears</td>
<td>E14</td>
</tr>
<tr>
<td>Strawberries (count 1 handful as 1 time)</td>
<td>E15</td>
</tr>
<tr>
<td>Cantaloupe/rockmelon or honeydew</td>
<td>E16</td>
</tr>
<tr>
<td>Watermelon</td>
<td>E17</td>
</tr>
<tr>
<td>Tinned or fresh pineapple</td>
<td>E18</td>
</tr>
<tr>
<td>Kiwi fruit</td>
<td>E19</td>
</tr>
<tr>
<td>Tinned peaches</td>
<td>E20</td>
</tr>
<tr>
<td>Dried or tinned apricots</td>
<td>E21</td>
</tr>
<tr>
<td>Other dried fruit</td>
<td>E22</td>
</tr>
<tr>
<td>Tinned fruit salad</td>
<td>E23</td>
</tr>
</tbody>
</table>

### F. VEGETABLES

For the following vegetables include all fresh, frozen, canned and dried vegetables unless the question asks for specific types.

<table>
<thead>
<tr>
<th>Vegetable Description</th>
<th>Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fresh tomatoes (raw or cooked)</td>
<td>F1</td>
</tr>
<tr>
<td>Canned tomatoes and tomato juice</td>
<td>F2</td>
</tr>
<tr>
<td>Tomato products including puree, paste or pasta sauce</td>
<td>F3</td>
</tr>
<tr>
<td>Iceberg lettuce</td>
<td>F4</td>
</tr>
<tr>
<td>Other lettuce and salad leaves (e.g. rocket, spinach, endive and chicory)</td>
<td>F5</td>
</tr>
<tr>
<td>Asian greens (e.g. Bok choy)</td>
<td>F6</td>
</tr>
<tr>
<td>Other cooked leafy vegetables (e.g. spinach, endive and silverbeet)</td>
<td>F7</td>
</tr>
<tr>
<td>Coleslaw</td>
<td>F8</td>
</tr>
</tbody>
</table>
### F. VEGETABLES continued

<table>
<thead>
<tr>
<th>Item</th>
<th>Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brussels sprouts or cooked cabbage</td>
<td>F9</td>
</tr>
<tr>
<td>Cauliflower</td>
<td>F10</td>
</tr>
<tr>
<td>Broccoli</td>
<td>F11</td>
</tr>
<tr>
<td>Sweet potato</td>
<td>F12</td>
</tr>
<tr>
<td>Capsicum</td>
<td>F13</td>
</tr>
<tr>
<td>Potato cooked in fat (e.g. roasted, sautéed or deep fried, including chips)</td>
<td>F14</td>
</tr>
<tr>
<td>Potato cooked without fat (e.g. steamed, boiled or baked in jacket)</td>
<td>F15</td>
</tr>
<tr>
<td>Asparagus</td>
<td>F16</td>
</tr>
<tr>
<td>Avocado</td>
<td>F17</td>
</tr>
<tr>
<td>Onion or leeks</td>
<td>F18</td>
</tr>
<tr>
<td>Celery</td>
<td>F19</td>
</tr>
<tr>
<td>Cucumber</td>
<td>F20</td>
</tr>
<tr>
<td>Mushrooms</td>
<td>F21</td>
</tr>
<tr>
<td>Pumpkin</td>
<td>F22</td>
</tr>
<tr>
<td>Zucchini or squash</td>
<td>F23</td>
</tr>
<tr>
<td>Eggplant</td>
<td>F24</td>
</tr>
<tr>
<td>Beetroot</td>
<td>F25</td>
</tr>
<tr>
<td>Green beans</td>
<td>F26</td>
</tr>
<tr>
<td>Green peas</td>
<td>F27</td>
</tr>
<tr>
<td>Carrots</td>
<td>F28</td>
</tr>
<tr>
<td>Garlic</td>
<td>F29</td>
</tr>
<tr>
<td>Sweet corn</td>
<td>F30</td>
</tr>
<tr>
<td>Baked beans</td>
<td>F31</td>
</tr>
<tr>
<td>Dried beans, dried peas, chick peas or lentils</td>
<td>F32</td>
</tr>
</tbody>
</table>

### G. MISCELLANEOUS FOODS

<table>
<thead>
<tr>
<th>Item</th>
<th>Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>Olives</td>
<td>G1</td>
</tr>
<tr>
<td>Pizza</td>
<td>G2</td>
</tr>
<tr>
<td>Pastries with cheese (e.g. quiche and spanakopita)</td>
<td>G3</td>
</tr>
<tr>
<td>Pastries with meat (e.g. meat pies and sausage rolls)</td>
<td>G4</td>
</tr>
<tr>
<td>Tomato sauce or ketchup</td>
<td>G5</td>
</tr>
<tr>
<td>Chocolate or confectionery containing chocolate</td>
<td>G6</td>
</tr>
<tr>
<td>Other confectionery</td>
<td>G7</td>
</tr>
<tr>
<td>Peanuts, peanut butter or peanut paste</td>
<td>G8</td>
</tr>
<tr>
<td>Other nuts</td>
<td>G9</td>
</tr>
<tr>
<td>Corn chips, potato crisps, Twisties etc.</td>
<td>G10</td>
</tr>
<tr>
<td>Jam, marmalade, honey or syrups</td>
<td>G11</td>
</tr>
<tr>
<td>Vegemite, Marmite or Promite</td>
<td>G12</td>
</tr>
</tbody>
</table>

---

### In the last 12 months did you take any type of dietary supplements, such as vitamins or minerals, at least once per week?

- **Yes** 1 (GO TO QUESTION 27)
- **No** 2 (GO TO QUESTION 28)
In the last 12 months, how often did you take any of the following dietary supplements?

For supplements other than multi-vitamins, only count them if you took them as separate supplements. For example, if you took a multi-vitamin pill that contains vitamin C, but did not take vitamin C separately, you would fill in the oval for multi-vitamins and NEVER for vitamin C.

<table>
<thead>
<tr>
<th>Times you have taken:</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
<th>11</th>
<th>12</th>
<th>13</th>
<th>14</th>
</tr>
</thead>
<tbody>
<tr>
<td>Less than once per month</td>
<td><img src="on" alt="circle" /></td>
<td><img src="on" alt="circle" /></td>
<td><img src="on" alt="circle" /></td>
<td><img src="on" alt="circle" /></td>
<td><img src="on" alt="circle" /></td>
<td><img src="on" alt="circle" /></td>
<td><img src="on" alt="circle" /></td>
<td><img src="on" alt="circle" /></td>
<td><img src="on" alt="circle" /></td>
<td><img src="on" alt="circle" /></td>
<td><img src="on" alt="circle" /></td>
<td><img src="on" alt="circle" /></td>
<td><img src="on" alt="circle" /></td>
<td><img src="on" alt="circle" /></td>
</tr>
<tr>
<td>1-3 times per month</td>
<td><img src="on" alt="circle" /></td>
<td><img src="on" alt="circle" /></td>
<td><img src="on" alt="circle" /></td>
<td><img src="on" alt="circle" /></td>
<td><img src="on" alt="circle" /></td>
<td><img src="on" alt="circle" /></td>
<td><img src="on" alt="circle" /></td>
<td><img src="on" alt="circle" /></td>
<td><img src="on" alt="circle" /></td>
<td><img src="on" alt="circle" /></td>
<td><img src="on" alt="circle" /></td>
<td><img src="on" alt="circle" /></td>
<td><img src="on" alt="circle" /></td>
<td><img src="on" alt="circle" /></td>
</tr>
<tr>
<td>1 time per week</td>
<td><img src="on" alt="circle" /></td>
<td><img src="on" alt="circle" /></td>
<td><img src="on" alt="circle" /></td>
<td><img src="on" alt="circle" /></td>
<td><img src="on" alt="circle" /></td>
<td><img src="on" alt="circle" /></td>
<td><img src="on" alt="circle" /></td>
<td><img src="on" alt="circle" /></td>
<td><img src="on" alt="circle" /></td>
<td><img src="on" alt="circle" /></td>
<td><img src="on" alt="circle" /></td>
<td><img src="on" alt="circle" /></td>
<td><img src="on" alt="circle" /></td>
<td><img src="on" alt="circle" /></td>
</tr>
<tr>
<td>2 times per week</td>
<td><img src="on" alt="circle" /></td>
<td><img src="on" alt="circle" /></td>
<td><img src="on" alt="circle" /></td>
<td><img src="on" alt="circle" /></td>
<td><img src="on" alt="circle" /></td>
<td><img src="on" alt="circle" /></td>
<td><img src="on" alt="circle" /></td>
<td><img src="on" alt="circle" /></td>
<td><img src="on" alt="circle" /></td>
<td><img src="on" alt="circle" /></td>
<td><img src="on" alt="circle" /></td>
<td><img src="on" alt="circle" /></td>
<td><img src="on" alt="circle" /></td>
<td><img src="on" alt="circle" /></td>
</tr>
<tr>
<td>3-4 times per week</td>
<td><img src="on" alt="circle" /></td>
<td><img src="on" alt="circle" /></td>
<td><img src="on" alt="circle" /></td>
<td><img src="on" alt="circle" /></td>
<td><img src="on" alt="circle" /></td>
<td><img src="on" alt="circle" /></td>
<td><img src="on" alt="circle" /></td>
<td><img src="on" alt="circle" /></td>
<td><img src="on" alt="circle" /></td>
<td><img src="on" alt="circle" /></td>
<td><img src="on" alt="circle" /></td>
<td><img src="on" alt="circle" /></td>
<td><img src="on" alt="circle" /></td>
<td><img src="on" alt="circle" /></td>
</tr>
<tr>
<td>5-6 times per week</td>
<td><img src="on" alt="circle" /></td>
<td><img src="on" alt="circle" /></td>
<td><img src="on" alt="circle" /></td>
<td><img src="on" alt="circle" /></td>
<td><img src="on" alt="circle" /></td>
<td><img src="on" alt="circle" /></td>
<td><img src="on" alt="circle" /></td>
<td><img src="on" alt="circle" /></td>
<td><img src="on" alt="circle" /></td>
<td><img src="on" alt="circle" /></td>
<td><img src="on" alt="circle" /></td>
<td><img src="on" alt="circle" /></td>
<td><img src="on" alt="circle" /></td>
<td><img src="on" alt="circle" /></td>
</tr>
<tr>
<td>1 time per day</td>
<td><img src="on" alt="circle" /></td>
<td><img src="on" alt="circle" /></td>
<td><img src="on" alt="circle" /></td>
<td><img src="on" alt="circle" /></td>
<td><img src="on" alt="circle" /></td>
<td><img src="on" alt="circle" /></td>
<td><img src="on" alt="circle" /></td>
<td><img src="on" alt="circle" /></td>
<td><img src="on" alt="circle" /></td>
<td><img src="on" alt="circle" /></td>
<td><img src="on" alt="circle" /></td>
<td><img src="on" alt="circle" /></td>
<td><img src="on" alt="circle" /></td>
<td><img src="on" alt="circle" /></td>
</tr>
<tr>
<td>2 times per day</td>
<td><img src="on" alt="circle" /></td>
<td><img src="on" alt="circle" /></td>
<td><img src="on" alt="circle" /></td>
<td><img src="on" alt="circle" /></td>
<td><img src="on" alt="circle" /></td>
<td><img src="on" alt="circle" /></td>
<td><img src="on" alt="circle" /></td>
<td><img src="on" alt="circle" /></td>
<td><img src="on" alt="circle" /></td>
<td><img src="on" alt="circle" /></td>
<td><img src="on" alt="circle" /></td>
<td><img src="on" alt="circle" /></td>
<td><img src="on" alt="circle" /></td>
<td><img src="on" alt="circle" /></td>
</tr>
<tr>
<td>3 or more times per day</td>
<td><img src="on" alt="circle" /></td>
<td><img src="on" alt="circle" /></td>
<td><img src="on" alt="circle" /></td>
<td><img src="on" alt="circle" /></td>
<td><img src="on" alt="circle" /></td>
<td><img src="on" alt="circle" /></td>
<td><img src="on" alt="circle" /></td>
<td><img src="on" alt="circle" /></td>
<td><img src="on" alt="circle" /></td>
<td><img src="on" alt="circle" /></td>
<td><img src="on" alt="circle" /></td>
<td><img src="on" alt="circle" /></td>
<td><img src="on" alt="circle" /></td>
<td><img src="on" alt="circle" /></td>
</tr>
</tbody>
</table>

In the last 12 months, how often did you drink any kind of alcoholic drink?

1 day per month or less often | ![circle](on) | ![circle](on) | ![circle](on) | ![circle](on) | ![circle](on) | ![circle](on) | ![circle](on) | ![circle](on) | ![circle](on) | ![circle](on) | ![circle](on) | ![circle](on) | ![circle](on) | ![circle](on) |
2-3 days per month | ![circle](on) | ![circle](on) | ![circle](on) | ![circle](on) | ![circle](on) | ![circle](on) | ![circle](on) | ![circle](on) | ![circle](on) | ![circle](on) | ![circle](on) | ![circle](on) | ![circle](on) | ![circle](on) |
1 day per week | ![circle](on) | ![circle](on) | ![circle](on) | ![circle](on) | ![circle](on) | ![circle](on) | ![circle](on) | ![circle](on) | ![circle](on) | ![circle](on) | ![circle](on) | ![circle](on) | ![circle](on) | ![circle](on) |
2 days per week | ![circle](on) | ![circle](on) | ![circle](on) | ![circle](on) | ![circle](on) | ![circle](on) | ![circle](on) | ![circle](on) | ![circle](on) | ![circle](on) | ![circle](on) | ![circle](on) | ![circle](on) | ![circle](on) |
3-4 days per week | ![circle](on) | ![circle](on) | ![circle](on) | ![circle](on) | ![circle](on) | ![circle](on) | ![circle](on) | ![circle](on) | ![circle](on) | ![circle](on) | ![circle](on) | ![circle](on) | ![circle](on) | ![circle](on) |
5-6 days per week | ![circle](on) | ![circle](on) | ![circle](on) | ![circle](on) | ![circle](on) | ![circle](on) | ![circle](on) | ![circle](on) | ![circle](on) | ![circle](on) | ![circle](on) | ![circle](on) | ![circle](on) | ![circle](on) |
Every day | ![circle](on) | ![circle](on) | ![circle](on) | ![circle](on) | ![circle](on) | ![circle](on) | ![circle](on) | ![circle](on) | ![circle](on) | ![circle](on) | ![circle](on) | ![circle](on) | ![circle](on) | ![circle](on) |
Never (GO TO QUESTION 37) | ![circle](on) | ![circle](on) | ![circle](on) | ![circle](on) | ![circle](on) | ![circle](on) | ![circle](on) | ![circle](on) | ![circle](on) | ![circle](on) | ![circle](on) | ![circle](on) | ![circle](on) | ![circle](on) |

In the last 12 months, how often did you drink beer?

1 day per month or less often | ![circle](on) | ![circle](on) | ![circle](on) | ![circle](on) | ![circle](on) | ![circle](on) | ![circle](on) | ![circle](on) | ![circle](on) | ![circle](on) | ![circle](on) | ![circle](on) | ![circle](on) | ![circle](on) |
2-3 days per month | ![circle](on) | ![circle](on) | ![circle](on) | ![circle](on) | ![circle](on) | ![circle](on) | ![circle](on) | ![circle](on) | ![circle](on) | ![circle](on) | ![circle](on) | ![circle](on) | ![circle](on) | ![circle](on) |
1 day per week | ![circle](on) | ![circle](on) | ![circle](on) | ![circle](on) | ![circle](on) | ![circle](on) | ![circle](on) | ![circle](on) | ![circle](on) | ![circle](on) | ![circle](on) | ![circle](on) | ![circle](on) | ![circle](on) |
2 days per week | ![circle](on) | ![circle](on) | ![circle](on) | ![circle](on) | ![circle](on) | ![circle](on) | ![circle](on) | ![circle](on) | ![circle](on) | ![circle](on) | ![circle](on) | ![circle](on) | ![circle](on) | ![circle](on) |
3-4 days per week | ![circle](on) | ![circle](on) | ![circle](on) | ![circle](on) | ![circle](on) | ![circle](on) | ![circle](on) | ![circle](on) | ![circle](on) | ![circle](on) | ![circle](on) | ![circle](on) | ![circle](on) | ![circle](on) |
5-6 days per week | ![circle](on) | ![circle](on) | ![circle](on) | ![circle](on) | ![circle](on) | ![circle](on) | ![circle](on) | ![circle](on) | ![circle](on) | ![circle](on) | ![circle](on) | ![circle](on) | ![circle](on) | ![circle](on) |
Every day | ![circle](on) | ![circle](on) | ![circle](on) | ![circle](on) | ![circle](on) | ![circle](on) | ![circle](on) | ![circle](on) | ![circle](on) | ![circle](on) | ![circle](on) | ![circle](on) | ![circle](on) | ![circle](on) |
Never (GO TO QUESTION 32) | ![circle](on) | ![circle](on) | ![circle](on) | ![circle](on) | ![circle](on) | ![circle](on) | ![circle](on) | ![circle](on) | ![circle](on) | ![circle](on) | ![circle](on) | ![circle](on) | ![circle](on) | ![circle](on) |

On the days when you drank beer during the last 12 months, how much did you usually drink in a single day?

<table>
<thead>
<tr>
<th>Amount:</th>
<th>NIL</th>
<th>Up to 1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6 or more</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pony (150ml)</td>
<td><img src="on" alt="circle" /></td>
<td><img src="on" alt="circle" /></td>
<td><img src="on" alt="circle" /></td>
<td><img src="on" alt="circle" /></td>
<td><img src="on" alt="circle" /></td>
<td><img src="on" alt="circle" /></td>
<td><img src="on" alt="circle" /></td>
</tr>
<tr>
<td>Glass (200ml)</td>
<td><img src="on" alt="circle" /></td>
<td><img src="on" alt="circle" /></td>
<td><img src="on" alt="circle" /></td>
<td><img src="on" alt="circle" /></td>
<td><img src="on" alt="circle" /></td>
<td><img src="on" alt="circle" /></td>
<td><img src="on" alt="circle" /></td>
</tr>
<tr>
<td>Pot or Middy (285ml)</td>
<td><img src="on" alt="circle" /></td>
<td><img src="on" alt="circle" /></td>
<td><img src="on" alt="circle" /></td>
<td><img src="on" alt="circle" /></td>
<td><img src="on" alt="circle" /></td>
<td><img src="on" alt="circle" /></td>
<td><img src="on" alt="circle" /></td>
</tr>
<tr>
<td>Stubby or can (375ml)</td>
<td><img src="on" alt="circle" /></td>
<td><img src="on" alt="circle" /></td>
<td><img src="on" alt="circle" /></td>
<td><img src="on" alt="circle" /></td>
<td><img src="on" alt="circle" /></td>
<td><img src="on" alt="circle" /></td>
<td><img src="on" alt="circle" /></td>
</tr>
<tr>
<td>Schooner (475ml)</td>
<td><img src="on" alt="circle" /></td>
<td><img src="on" alt="circle" /></td>
<td><img src="on" alt="circle" /></td>
<td><img src="on" alt="circle" /></td>
<td><img src="on" alt="circle" /></td>
<td><img src="on" alt="circle" /></td>
<td><img src="on" alt="circle" /></td>
</tr>
<tr>
<td>Pint (560ml)</td>
<td><img src="on" alt="circle" /></td>
<td><img src="on" alt="circle" /></td>
<td><img src="on" alt="circle" /></td>
<td><img src="on" alt="circle" /></td>
<td><img src="on" alt="circle" /></td>
<td><img src="on" alt="circle" /></td>
<td><img src="on" alt="circle" /></td>
</tr>
<tr>
<td>Bottles (750ml)</td>
<td><img src="on" alt="circle" /></td>
<td><img src="on" alt="circle" /></td>
<td><img src="on" alt="circle" /></td>
<td><img src="on" alt="circle" /></td>
<td><img src="on" alt="circle" /></td>
<td><img src="on" alt="circle" /></td>
<td><img src="on" alt="circle" /></td>
</tr>
</tbody>
</table>
In the last 12 months, how much of the beer you drank was light beer? Light beer is sometimes called low alcohol beer.

<table>
<thead>
<tr>
<th>Amount</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>All or almost all</td>
<td>1</td>
</tr>
<tr>
<td>More than half</td>
<td>2</td>
</tr>
<tr>
<td>About half</td>
<td>3</td>
</tr>
<tr>
<td>Less than half</td>
<td>4</td>
</tr>
<tr>
<td>None or almost none</td>
<td>5</td>
</tr>
</tbody>
</table>

In the last 12 months, how often did you drink wine?

<table>
<thead>
<tr>
<th>Frequency</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1 day per month or less often</td>
<td>1</td>
</tr>
<tr>
<td>2-3 days per month</td>
<td>2</td>
</tr>
<tr>
<td>1 day per week</td>
<td>3</td>
</tr>
<tr>
<td>2 days per week</td>
<td>4</td>
</tr>
<tr>
<td>3-4 days per week</td>
<td>5</td>
</tr>
<tr>
<td>5-6 days per week</td>
<td>6</td>
</tr>
<tr>
<td>Every day</td>
<td>7</td>
</tr>
<tr>
<td>Never (GO TO QUESTION 35)</td>
<td>8</td>
</tr>
</tbody>
</table>

On the days when you drank wine during the last 12 months, how much did you usually drink in a single day?

Amount:

Remember to fill in only one oval on every line

<table>
<thead>
<tr>
<th>Amount</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Glasses (150ml)</td>
<td>1</td>
</tr>
<tr>
<td>Bottles (750ml)</td>
<td>2</td>
</tr>
<tr>
<td>Litre</td>
<td>3</td>
</tr>
</tbody>
</table>

In the last 12 months, how much of the wine you drank was red wine?

<table>
<thead>
<tr>
<th>Amount</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>All or almost all</td>
<td>1</td>
</tr>
<tr>
<td>More than half</td>
<td>2</td>
</tr>
<tr>
<td>About half</td>
<td>3</td>
</tr>
<tr>
<td>Less than half</td>
<td>4</td>
</tr>
<tr>
<td>None or almost none</td>
<td>5</td>
</tr>
</tbody>
</table>

In the last 12 months, how often did you drink spirits? Spirits include whisky, gin, vodka, brandy, grappa, rum, on their own or as mixed drinks.

<table>
<thead>
<tr>
<th>Frequency</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1 day per month or less often</td>
<td>1</td>
</tr>
<tr>
<td>2-3 days per month</td>
<td>2</td>
</tr>
<tr>
<td>1 day per week</td>
<td>3</td>
</tr>
<tr>
<td>2 days per week</td>
<td>4</td>
</tr>
<tr>
<td>3-4 days per week</td>
<td>5</td>
</tr>
<tr>
<td>5-6 days per week</td>
<td>6</td>
</tr>
<tr>
<td>Every day</td>
<td>7</td>
</tr>
<tr>
<td>Never (GO TO QUESTION 37)</td>
<td>8</td>
</tr>
</tbody>
</table>

On the days when you drank spirits during the last 12 months, how much did you usually drink in a single day?

Amount:

Remember to fill in only one oval on every line

<table>
<thead>
<tr>
<th>Amount</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Glasses (200ml)</td>
<td>1</td>
</tr>
<tr>
<td>Nips or Shots (30ml)</td>
<td>2</td>
</tr>
<tr>
<td>Premix Bottles (300ml)</td>
<td>3</td>
</tr>
<tr>
<td>Premix Cans (375ml)</td>
<td>4</td>
</tr>
<tr>
<td>Bottles (750ml)</td>
<td>5</td>
</tr>
</tbody>
</table>
In the last 12 months, how often did you drink tea?

- Never or less than once per month (1)
- 1-3 cups per month (2)
- 1 cup per week (3)
- 2-4 cups per week (4)
- 5-6 cups per week (5)
- 1 cup per day (6)
- 2-3 cups per day (7)
- 4-5 cups per day (8)
- 6+ cups per day (9)

In the last 12 months, how often did you drink coffee?

- Never or less than once per month (1)
- 1-3 cups per month (2)
- 1 cup per week (3)
- 2-4 cups per week (4)
- 5-6 cups per week (5)
- 1 cup per day (6)
- 2-3 cups per day (7)
- 4-5 cups per day (8)
- 6+ cups per day (9)

In the last 12 months, how often did you drink herbal tea?

- Never or less than once per month (1)
- 1-3 cups per month (2)
- 1 cup per week (3)
- 2-4 cups per week (4)
- 5-6 cups per week (5)
- 1 cup per day (6)
- 2-3 cups per day (7)
- 4-5 cups per day (8)
- 6+ cups per day (9)

In the last 12 months, how often did you drink coffee substitute?

- Never or less than once per month (1)
- 1-3 cups per month (2)
- 1 cup per week (3)
- 2-4 cups per week (4)
- 5-6 cups per week (5)
- 1 cup per day (6)
- 2-3 cups per day (7)
- 4-5 cups per day (8)
- 6+ cups per day (9)

Thank you for taking the time to complete this questionnaire. Please check that you have completed all twelve pages.

If found, please return to:
Cancer Epidemiology Centre
The Cancer Council Victoria
1 Rathdowne Street
Carlton VIC 3053

Telephone: 03 9635-5000
Facsimile: 09 9635-5270

www.cancervic.org.au

© Copyright The Cancer Council Victoria 2005.
Appendix 5

Written intervention material included at baseline as part of the mums OnLiNE pilot intervention study
Welcome to the mums OnLiNE program – a unique addition to INFANT, specifically designed for first time mums! I will be helping you achieve your healthy lifestyle goals over the next 9 months and I’m looking forward to working with you!

The mums OnLiNE program is made up of 4 components:

• Access to the online Calorie King healthy lifestyle program

• Individual Dietitian telephone calls with you (x 3) throughout the mums OnLiNE program

• Optional use of a mums OnLiNE blog (http://mumsonline.aussieblogs.com.au) for lots of healthy lifestyle advice, recipes, discussion and more!

• Written material (enclosed) which will help with the mums OnLiNE program

Your first phone call with Paige has been scheduled for

____________________________ at ____________________________.

Each of the mums OnLiNE components will be discussed in more detail during the phone call, which will be the start of the mums OnLiNE program for you!

I have enclosed some written material which we will discuss during our first phone call. Feel free to take a look beforehand but don’t worry if you don’t get a chance. The mums OnLiNE program is designed to be informative, supportive and fun and I’m thrilled to welcome you!

With healthy regards,

Paige van der Pligt
(Dietitian)
An active way to better health.

NATIONAL PHYSICAL ACTIVITY GUIDELINES FOR ADULTS

National Physical Activity guidelines for adults brochure

Pedometer
Setting Goals - Step by step goals for a more healthy YOU!

In order to achieve and maintain healthy lifestyle choices and a healthy weight, it is often useful to set goals and then keep track of them. It’s also good to think about your motivation and any barriers that seem to stop you reaching your goals. You may like to plan and reassess your goals by using the table below. This can be helpful for sustaining long term healthy lifestyle habits. An example has been provided for you.

**Remember:** Setting goals can be challenging but setting ‘SMART’ goals (Specific, Measureable, Attainable, Relevant, Timely) is the best approach.

<table>
<thead>
<tr>
<th>Date</th>
<th>Weight goal (kg)</th>
<th>Waist goal (cm)</th>
<th>Dietary goal</th>
<th>Physical Activity goal</th>
<th>Motivation</th>
<th>Barriers</th>
<th>Goals achieved</th>
<th>Strategies</th>
</tr>
</thead>
<tbody>
<tr>
<td>15/5/12</td>
<td>72kg</td>
<td>85cm</td>
<td>Reduce portion sizes at dinner time by approximately a quarter</td>
<td>Increase my walking to 3 times per week for 45 minutes each</td>
<td>High – I’m feeling like I have more energy and I’m able to continue making changes</td>
<td>I’m more tired at night time after returning to work full time</td>
<td>Achieved dietary goals and my weight is 72.5kg</td>
<td>Will try to walk in the mornings before work and try getting to bed a little earlier</td>
</tr>
</tbody>
</table>
CalorieKing calorie, fat and carbohydrate counting book

How do I measure my waist circumference?

Simple!

- Place the tape measure directly on your skin
- The correct place to measure is horizontally, halfway between your lowest rib and the top of your hipbone. This is likely to be in line with your belly button
- Breathe out normally
- Ensure the tape is snug, firm but comfortable

Instructions for measuring waist circumference

Tape measure for self-monitoring waist circumference
mums OnLiNE

Calorie King website user guide for mums

Calorie King

AUSTRALIA

DEAKIN

UNIVERSITY AUSTRALIA
In this booklet you will find instructions on how to use some of the most important features of CalorieKing.

The first step is to go to www.calorieking.com.au
1. STEPS TO JOIN CALORIE KING

2. Click on: JOIN CALORIEKING
   Type in your:           - Height (cm)     - Weight (kg)
                          - Gender     - Age
   Click on: Go
3. Type in your: First name
               Last name
               Username  (4 or more characters)
               Password  (4 or more characters)
               Email
               Postcode
               State

   Note – this information will not be shared with anyone and your username
   and password are private

4. Click on: Terms and Conditions (please read).
5. Click on the box, agreeing to the website Terms and Conditions
   and confirming that you are over 16 years of age.
6. Click on: Next
   You will now be sent a confirmation email to activate your
   account.
7. Go to your email account and check for an email from CalorieKing.
   (Check your junk or spam folder if it’s not in your inbox.) This will contain
   important information on how to confirm your account with CalorieKing.
8. Click on the link provided in the email to confirm your account.
9. Click on: Continue to CalorieKing and then enter your
    username and password.
10. Click on: GO
11. You will now need to complete your personal profile.
    If you have any problems or questions please email Paige at
    p.vanderpligt@deakin.edu.au

During your first phone call with a Dietitian, these values will be provided to you and will be from measurements taken at your recent INFANT session.
2. SETTING UP YOUR PERSONAL PROFILE

Once you have logged in, you will see a screen saying that you have not yet completed your Personal Profile. Click on the Click here link to do that now.

2.1 Physical Profile

First you will have to enter your gender, date of birth, height and weight.

- **Sex**: Male
- **Date of birth**: 1 Jan 1947
- **Height without shoes**: 185 cm
- **Weight in light clothing**: From Check-In

Remember if you are pregnant or become pregnant during the mums OnLiNE program please alert us as you will need to withdraw from using the program. Energy restriction during pregnancy is not appropriate.
Choose your goal as “Lose weight” if your current weight places you outside the healthy BMI range (this will be discussed with your Dietitian during your first phone call) or if you are already a healthy weight but you want to return to your pre pregnancy body weight.

Enter a target weight (This will also be discussed with your Dietitian).

Please note, this recommended target weight is based on a BMI of 20-25. Your target weight can be changed later on.

Diet Profile

Your goal is to: ☐ Lose weight ☐ Maintain weight ☐ Gain weight

Your height is 185cm, we recommended a target weight of between 68 kgs and 86 kgs.

Your target weight is: 85 kg

Lifestyle

Tell us about your lifestyle. This is dependant on your occupation, rather than the exercise you do. Pick the option that best describes you:

☐ Sedentary - I am immobile most of the time.

☐ Light - I work in an office or do light house cleaning, shopping or driving, but primarily I sit most of the day.

☐ Moderate - I have an “on-the-go” job, with very little time to sit down (e.g. Sales person).

☐ Active - My job requires me to do heavy lifting or moving. (e.g. Builder)

Choose your “lifestyle” category.
If you are unsure about your lifestyle category we would suggest “Light” as an average activity level.

Tick the “Generate a meal plan”.
Change your check-in day to a day of the week that suits you.

Meal Plans

You can choose for us to generate meal plans for you to use as part of our membership. The meal plans generated are customised to your needs and compiled by dietitians.

- Generate a meal plan

Check-In Day

Your check-in day is the day of the week where you'd like to make weekly check-ins of your weight and other measurements.

**

Tick any medical condition you have:

Health Profile

Do you have, or are you being medically treated for, any of the following conditions?

Note that the boxes you tick here won’t directly affect your meal plan. You can manually alter your meal plan meals to match your condition.

- Heart disease
- High blood pressure
- High cholesterol
- Hypoglycemia
- Type II diabetes
- Other medical condition

Click “Next”
2.2 Diet Profile
Set up your maximum Calorie intake and starting exercise goal:

This will be calculated from the information you supplied earlier about your height and weight and activity level. This will also be discussed with your Dietitian on the telephone. The example used here is 1850 calories per day.

This recommendation is in Calories. In this example, 1850 Calories is equivalent to 7770kJ.

The kilojoule value can be calculated by multiplying the Calories by 4.2. (i.e. 1850 x 4.2 = 7770kJ).

Set your Exercise Goal at 30 minutes per day to begin with.

You can change both your Calorie target and exercise goal as often as you need.
The next screen you see will look like this:
(You don’t need to do anything with this.)

Target Weight

To help you maintain focus, we have given you an intermediate weight goal of 95 kg.

When you reach this initial goal, you will receive a new goal, at a weight closer to your target.

---

Nutrient Targets

Optionally, specify any daily nutrient targets for your diet. These will NOT affect your generated meal plan.

<table>
<thead>
<tr>
<th>We Recommend</th>
<th>We Recommend</th>
</tr>
</thead>
<tbody>
<tr>
<td>Protein: (g)</td>
<td>114 g</td>
</tr>
<tr>
<td>Fat: (g)</td>
<td>55 g</td>
</tr>
<tr>
<td>Saturated Fat: (g)</td>
<td>114 g</td>
</tr>
<tr>
<td>Carbohydrate: (g)</td>
<td>225 g</td>
</tr>
<tr>
<td>Fibre: (g)</td>
<td></td>
</tr>
<tr>
<td>Cholesterol: (mg)</td>
<td></td>
</tr>
<tr>
<td>Sodium: (mg)</td>
<td></td>
</tr>
<tr>
<td>Calcium: (mg)</td>
<td></td>
</tr>
<tr>
<td>Iron: (mg)</td>
<td></td>
</tr>
</tbody>
</table>

If you eat mostly home-cooked meals, select “Recipes and Basics” here. If you eat mostly convenience foods (such as frozen meals or take-aways), select “Convenience and Basics”.

---

Meal Plan Options

Select your preference for recipe-based meals or convenience meals for breakfast, lunch and dinner:

<table>
<thead>
<tr>
<th>Recipes &amp; Basics</th>
<th>Convenience &amp; Basics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Breakfast</td>
<td></td>
</tr>
<tr>
<td>Lunch</td>
<td></td>
</tr>
<tr>
<td>Dinner</td>
<td></td>
</tr>
</tbody>
</table>
If you have any special dietary needs, select them here:

Tick the boxes below to fine-tune your food preferences. Bear in mind that the more boxes you tick, the smaller the variety in your meal plan will be.

**Food Preferences**
- No meat at all
- No beef
- No lamb
- No veal
- No pork, ham or bacon
- No poultry
- No finned fish
- No shellfish
- No dairy

**Allergies & Intolerances**
- Low lactose
- No gluten

**Additional Options**
- No fast-food

Click on “Next” and you’re done!

---

**CALORIEKING CLUB**

Home » Diet Diary » Personal Profile

---

**Personal Profile**

You have now completed your Personal Profile and your Today page has been updated.

If you want to change your profile settings at any time in the future, you can click the ‘Take your personal profile’ under Account Settings.

---

**Medical Conditions**

If you have a medical condition, or are under medical supervision, please seek advice before dieting.

We do not currently customise your meal plan to account for your medical condition, so it will be necessary for you to make some changes manually.

We recommend that you visit your Today page whenever you visit CalorieKing.com.au.

Click here to visit your Today page now!
3. FOOD & EXERCISE DIARY

We suggest you record everything you eat, drink and the exercise you complete on at least 4 days of the week. The mums OnLiNE program runs for the next nine months and it's up to you how often you log your nutrition and exercise details and your weight. This will depend on whether or not you are achieving your healthy lifestyle goals. You can discuss this with your Dietitian during the telephone calls.

3.1 Recording Food

1. To access the Food and Exercise Diary, after you have logged in, click on “Record your food and view meal plan” or select the “Food & Exercise Diary” in the CLUB dropdown menu.
2. Enter a meal for breakfast, type in the food or beverage in the food column on the right, click ‘Find Foods’ and the database will be searched.
3. Then simply click on the correct food from the results of the search and select the serving size of the food, and at which meal (breakfast, lunch, dinner or snacks) you ate it. If it is a food you eat regularly, check the box that says “Mark this food as a Favourite”. This will save you time later.

If you are unsure about serving sizes, it may be useful to have some scales at home to weigh the amount of food you usually eat – especially for foods you eat frequently (e.g. cereals, pasta, rice etc...).
The food you selected will automatically appear in the food record in the left column.

4. Repeat steps 2 and 3 for all foods you eat in a day.

5. If you have made a mistake, click on the red (x) next to the food entry in the diary and it will be deleted.

6. All Calorie/kilojoule intakes are displayed on the right of the column and at the bottom of the page in the Calorie barometer.
3.2 Saving and Loading Meals

One of the most important features of the CalorieKing website is the 'save' and 'load' meals option. We **strongly recommend you ‘save’ & ‘load’ meals.** This will save you a considerable amount of time, especially for meals you eat frequently (e.g. breakfast and lunch).

(1) Saving

1. All you have to do is click on the “Save Meal” option once you have entered all the foods.

   ![Image](image1)

2. Give your meal a name and click on Save Meal.

   ![Image](image2)
(2) Loading

1. To load a meal, just click on the **Load Meal** option on the Food and Exercise Diary section.

2. Then, you can enter the same meal on another day just by selecting the saved meal from the drop-down menu and clicking **Load Meal**.

3. For those foods you don’t eat in the meal, you can de-select them by clicking on the tick in the load meal menu.
### 3.3 Recording Exercise

1. Record your daily exercise by clicking on the Exercise tab in the column on the right.

   Use this exercise diary to record your daily exercise. To get started, search for the exercise you’ve done in the search box above.

   If you find you do some exercises more than others, you can add them to your Favourite Exercises.

   If you find that you are doing an exercise that’s not on our list, you can create Custom Exercises.

2. Enter any exercise you’ve completed in the search box (eg. walking, cycling, tennis etc). This does not include exercise that is a part of your occupation or job as this has already been accounted for based on your lifestyle category.

3. Select one of the options found in the database.
This will be recorded on your Food and Exercise Diary on the left and deduct the Calories expended during the exercise from your total Calorie intake to give you a net Calorie intake. To give you a bit of an idea here, a brisk walking pace is often thought to be about 5-6 kph while a leisurely stroll could be somewhere around 4 kph.

3.4 The Weight Loss Barometer

*The weight loss barometer found at the bottom of the Food and Exercise Diary should be the focus of your website use.* Every time you enter a food or drink, the column will fill up. Every time you enter exercise, the column will reduce. The main aim is to keep some white space left at the end of the day.

Every day that you have white space left is a weight loss day, every day over is a weight gain day. The aim is to have white space left on most, preferably all days of the week.

If you consume more calories than your calorie budget allows, the weight loss barometer will fill up. Any days when you go over your calorie budget is a weight gain day.

If you go over your calorie budget you could include some exercise into your daily routine. This will bring the weight loss barometer down again and help you have some white space left at the end of the day.
4. CHECK-IN DIARY

You should record your weight and waist circumference on the CalorieKing website. We recommend you do this weekly, on the same day of the week. You can use the tape measure you were given to measure your waist circumference.

To record your weight and waist circumference on the CalorieKing website, select the **Check-in Diary** option in the CLUB dropdown menu.

---

**RECORD**

It is essential to record your food and exercise every day. Learn why!

- Record your food and view meal plan (0 cals)
- Record your exercise (0:30 mins)

Your net calories today are: 0 kcal!

Your fluid intake today is: 0 glasses

You get a green tick for each step you successfully complete.

/ NOTE: Activity Incomplete /

---

**CHECK-IN**

Check-ins are an important part of the program. Checking in once a week helps you stay motivated and keep on track with your weight loss goals.

- Checked in weight as of 13th Aug: 72 kg
- Next target weight: 68 kg (You should lose 4 kg)

Your next checkin is now overdue.

Click here to review and see graphs of previous check-ins.

/ NOTE: Activity Incomplete /

---

From here, click on the **Record your current weight and body measurements** option. The graph will show you your previous check in weights, your current weight and your future goals.

---

**CALORIE KING CLUB**

- You are on, or past, your check-in day. Click here to check-in now

Your Check-in Diary is where you can record changes in your weight and measurements at regular intervals. Tracking your progress is an important part of our diet plan, it helps keep you motivated and tells you when you may be slipping behind.

We recommend you check in once a week on your nominated check in day. If you happen to miss your check in day, you can still check in any time after that day.

- Your nominated check-in day is every Saturday. Click here to change your check-in day.
- Your next checkin is on: Your checkin is overdue.

How are you doing? View your check-in analysis.

---

**Track Your Progress**

- Record your current weight and body measurements.

**Weight**

<table>
<thead>
<tr>
<th>Start Weight</th>
<th>Current Weight</th>
<th>Current Target</th>
<th>Final Target</th>
</tr>
</thead>
<tbody>
<tr>
<td>72 kg</td>
<td>72 kg</td>
<td>68 kg</td>
<td>68 kg (change)</td>
</tr>
</tbody>
</table>
Make sure the date is correct and enter your **weight** (in kg) and **waist circumference** (in cm).

Finally, click **Save** to record all your data.
5. CHARTS & REPORTS

The “Charts and Reports” option allows you to see your information in a format that breaks down your progress into several options.

It summarises several features including your weight loss from week-to-week, your Calorie intake and output as well as a breakdown of where your Calories come from (i.e. carbohydrates, protein & fat).

To use the Charts and Reports function, select the link in the CLUB dropdown menu.
After clicking the link, you will be taken to the Charts and Reports overview page:

The Charts and Reports page has several options to choose from, with time intervals ranging from one week to a year.

(1) **Check-Ins:**
*How have my weight and measurements changed?*
This section has charts displaying your weight and body measurement histories within a weight range that has been tailored to your individual CalorieKing program.

(2) **Daily Averages and Breakdowns:**
*Where are my Calories coming from?*
This section has a list of your weekly Calorie intake, exercise expenditure and nutrients averaged to one day. There is also a handy pie chart to show you your ratio of Calories from fat, carbohydrate and protein. The recommended daily intake of fat is 20-35%.
(3) Calories:
*What is my Calorie intake?*
This menu shows your exercise, food and net Calories (your food Calories minus those you have burnt off with exercise).

(4) Calories (under or over):
*Am I above or below my daily Calorie target?*
This section contains 3 tables similar to those of the Calories section which show your exercise, food and net Calories in regards to the amount over or under your target you are each day.

For example: In the Food Calories table you will notice the heading contains your daily target, and the green bars will either rest above or below this line (which has the value of zero). If you are checking this at the start of the week you will notice each day is in deficit to the exact value of your target, and as you add your Calorie intake from food they will move up towards zero. This works in a similar manner for net and exercise Calories.

(5) Nutrients:
*What is my weekly nutrient intake?*
This will appear as a bar chart showing similar information as the **Daily Averages and Breakdowns** section, with the inclusion of fibre. It is recommended that you consume 30g of fibre per day.

![Nutrient Graph](image)

<table>
<thead>
<tr>
<th>Date</th>
<th>Fat</th>
<th>Carbs</th>
<th>Protein</th>
<th>Fibre</th>
</tr>
</thead>
<tbody>
<tr>
<td>9/9</td>
<td>100</td>
<td>50</td>
<td>10</td>
<td>20</td>
</tr>
<tr>
<td>10/9</td>
<td>150</td>
<td>100</td>
<td>5</td>
<td>30</td>
</tr>
<tr>
<td>11/9</td>
<td>50</td>
<td>20</td>
<td>20</td>
<td>10</td>
</tr>
<tr>
<td>12/9</td>
<td>10</td>
<td>5</td>
<td>10</td>
<td>5</td>
</tr>
<tr>
<td>13/9</td>
<td>15</td>
<td>15</td>
<td>15</td>
<td>15</td>
</tr>
<tr>
<td>14/9</td>
<td>20</td>
<td>20</td>
<td>20</td>
<td>20</td>
</tr>
<tr>
<td>15/9</td>
<td>25</td>
<td>25</td>
<td>25</td>
<td>25</td>
</tr>
</tbody>
</table>
10,000 Steps
*How many steps have I taken?*
Remember you received a pedometer at your second INFANT session. Using a pedometer to measure your activity level throughout the day can be a good way to remember to keep active, this section relates back to your food and exercise diary entries.

**Good Luck with this part of the mums OnLiNE healthy lifestyle program! I hope you enjoy using the CalorieKing website!**

**QUESTIONS FOR PAIGE**

If you have any specific questions that you would like to ask Paige regarding use of the website or issues relating to your eating, exercise and weight loss, you may email

p.vanderpligt@deakin.edu.au

This website user guide has been produced from the SHED – IT project user guide in conjunction with and with permission from the University of Newcastle, Australia.
Appendix 6

mums OnLiNE intervention

Modified Food Frequency Questionnaire (Baseline)
Welcome back to the INFANT Study

This survey asks about your knowledge, thoughts and practices around food and physical activity. You will remember some of these questions from the last survey you did – so this survey will be easier than the last just because you’ve practiced. It is also a shorter survey. We ask these questions more than once during the INFANT study to help to explain how mothers’ views and practices may change when they have a family.

Once you have finished your survey, please bring it with you to your next INFANT session scheduled in approximately two weeks time. Thank you for taking the time to complete the survey. It will take you about 20 minutes to complete, although this might vary depending on your answers.

Privacy and confidentiality
The information you provide in the survey is completely confidential. All completed surveys will be kept in secure storage at Deakin University.

Contact details
Please contact Paige van der Pligt if you have any questions about the survey.

Paige van der Pligt: email: p.vanderpligt@deakin.edu.au
Important Instructions – Please Read

Please answer each question by shading the most suitable option.

Where you are asked to write an answer please answer in the space provided.

If you are unsure about how to answer a question, please choose the answer that is closest to how you feel. Please do not leave questions unanswered.

Please answer questions in the following way:

When asked to circle your answer, please do so like this:

<table>
<thead>
<tr>
<th>Enjoys a lot</th>
<th>Enjoys</th>
<th>Neither</th>
<th>Dislikes</th>
<th>Dislikes a lot</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:

If you make a mistake cross it out and clearly mark the correct answer by shading the circle.

Fill in the circles clearly like this:

In general, would you say your health is: (shade one response only)

<table>
<thead>
<tr>
<th>Poor</th>
<th>Fair</th>
<th>Good</th>
<th>Very good</th>
<th>Excellent</th>
</tr>
</thead>
<tbody>
<tr>
<td>☐ 1</td>
<td>☐ 2</td>
<td>◦ 3</td>
<td>☐ 4</td>
<td>☐ 5</td>
</tr>
</tbody>
</table>

You would shade this circle if you think your health is good

Correct mistakes like this:

In general, would you say your health is: (shade one response only)

<table>
<thead>
<tr>
<th>Poor</th>
<th>Fair</th>
<th>Good</th>
<th>Very good</th>
<th>Excellent</th>
</tr>
</thead>
<tbody>
<tr>
<td>☐ 1</td>
<td>◦ 2</td>
<td>◯ 3</td>
<td>☐ 4</td>
<td>☐ 5</td>
</tr>
</tbody>
</table>

If you make a mistake cross it out and clearly mark the correct answer by shading the circle.
SECTION A: YOUR OWN ACTIVITIES

QA1 On a usual weekday (Monday through to Friday), about how many hours do you usually spend sitting down and watching television or videos/DVDs? (In hours and/or minutes) 

________ hours and _______ minutes each weekday

QA2 On a usual weekend day (Saturday or Sunday), about how many hours do you usually spend sitting down and watching television or videos/DVDs? (In hours and/or minutes) 

________ hours and _______ minutes each weekend day

In the following section we want you to think about the physical activities that you have done in the last week.

QA3 In the last week, how many times have you walked continuously, for at least 10 minutes, for recreation, exercise or to get to or from places?

____ times

QA4 What do you estimate was the total time that you spent walking in this way in the last week? (In hours and/or minutes)

_________ hours and _______ minutes

QA5 In the last week, how many times did you do any vigorous gardening or heavy work around the yard, which made you breathe harder or puff and pant?

____ times

QA6 What do you estimate was the total time that you spent doing vigorous gardening or heavy work around the yard in the last week? (In hours and/or minutes)

_________ hours and _______ minutes

The next questions exclude household chores, gardening or yard work.

QA7 In the last week, how many times did you do any vigorous physical activity which made you breathe harder or puff and pant? (e.g. jogging, cycling, aerobics, competitive tennis)

____ times
QA8  What do you estimate was the total time that you spent doing this vigorous physical activity in the last week? (In hours and/or minutes)

________ hours and _______ minutes

QA9  In the last week, how many times did you do any other more moderate physical activities that you have not already mentioned? (e.g. gentle swimming, social tennis, golf)

_____ times

QA10 What do you estimate was the total time that you spent doing these activities in the last week? (In hours and/or minutes)

________ hours and _______ minutes

QA11 How confident are you that you could do physical activity, in each of the following situations, over the next year? (Please shade one response on each line).

<table>
<thead>
<tr>
<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. Do physical activity when I am tired</td>
<td>O₁</td>
<td>O₂</td>
<td>O₃</td>
<td>O₄</td>
<td>O₅</td>
</tr>
<tr>
<td>b. Do physical activity when I am in a bad mood</td>
<td>O₁</td>
<td>O₂</td>
<td>O₃</td>
<td>O₄</td>
<td>O₅</td>
</tr>
<tr>
<td>c. Do physical activity when I don’t have time</td>
<td>O₁</td>
<td>O₂</td>
<td>O₃</td>
<td>O₄</td>
<td>O₅</td>
</tr>
<tr>
<td>d. Do physical activity when I am on holiday</td>
<td>O₁</td>
<td>O₂</td>
<td>O₃</td>
<td>O₄</td>
<td>O₅</td>
</tr>
<tr>
<td>e. Do physical activity when it is raining</td>
<td>O₁</td>
<td>O₂</td>
<td>O₃</td>
<td>O₄</td>
<td>O₅</td>
</tr>
</tbody>
</table>

QA12 How much attention do you usually pay to: (Please shade one response on each line.)

<table>
<thead>
<tr>
<th></th>
<th>None</th>
<th>A little</th>
<th>Some</th>
<th>Much</th>
<th>Very much</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. Your personal health habits?</td>
<td>O₁</td>
<td>O₂</td>
<td>O₃</td>
<td>O₄</td>
<td>O₅</td>
</tr>
<tr>
<td>b. Getting enough physical activity?</td>
<td>O₁</td>
<td>O₂</td>
<td>O₃</td>
<td>O₄</td>
<td>O₅</td>
</tr>
<tr>
<td>c. Eating a healthy low-fat diet?</td>
<td>O₁</td>
<td>O₂</td>
<td>O₃</td>
<td>O₄</td>
<td>O₅</td>
</tr>
<tr>
<td>d. Controlling your weight?</td>
<td>O₁</td>
<td>O₂</td>
<td>O₃</td>
<td>O₄</td>
<td>O₅</td>
</tr>
</tbody>
</table>
SECTION B: FOOD AND EATING

QB1  About how many serves of vegetables do you usually eat per day? Do not include potatoes, hot chips or fried potato. (1 serve = ½ cup cooked vegetables or 1 cup salad vegetables). (Please shade one response only)

<table>
<thead>
<tr>
<th>I don’t eat vegetables</th>
<th>1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Less than one serve/day</td>
<td>2</td>
</tr>
<tr>
<td>1 serve/day</td>
<td>3</td>
</tr>
<tr>
<td>2 serves/day</td>
<td>4</td>
</tr>
<tr>
<td>3 serves/day</td>
<td>5</td>
</tr>
<tr>
<td>4 serves/day</td>
<td>6</td>
</tr>
<tr>
<td>5 serves/day</td>
<td>7</td>
</tr>
<tr>
<td>6 serves or more/day</td>
<td>8</td>
</tr>
</tbody>
</table>

QB2  About how many serves of hot chips, French fries, wedges, or fried potatoes do you usually eat per week? (1 serve = a small cup) (Please shade one response only)

<table>
<thead>
<tr>
<th>I don’t eat chips</th>
<th>1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Less than one serve/week</td>
<td>2</td>
</tr>
<tr>
<td>1 serve/week</td>
<td>3</td>
</tr>
<tr>
<td>2 serves/week</td>
<td>4</td>
</tr>
<tr>
<td>3 serves/week</td>
<td>5</td>
</tr>
<tr>
<td>4 serves/week</td>
<td>6</td>
</tr>
<tr>
<td>5 serves/week</td>
<td>7</td>
</tr>
<tr>
<td>6 serves or more/week</td>
<td>8</td>
</tr>
</tbody>
</table>

QB3  About how many serves of potatoes do you usually eat per week? Do not include chips, French fries, wedges or fried potatoes. (1 serve = 1 small potato) (Please shade one response only)

<table>
<thead>
<tr>
<th>I don’t eat potatoes</th>
<th>1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Less than one serve/week</td>
<td>2</td>
</tr>
<tr>
<td>1 serve/week</td>
<td>3</td>
</tr>
<tr>
<td>2 serves/week</td>
<td>4</td>
</tr>
<tr>
<td>3 serves/week</td>
<td>5</td>
</tr>
<tr>
<td>4 serves/week</td>
<td>6</td>
</tr>
<tr>
<td>5 serves/week</td>
<td>7</td>
</tr>
<tr>
<td>6 serves or more/week</td>
<td>8</td>
</tr>
</tbody>
</table>
QB4 About how many serves of fruit do you usually eat per day? Do NOT include fruit juice.
(1 serve = 1 medium piece or 2 small pieces of fruit or 1 cup of diced pieces)
(Please shade one response only)

- I don’t eat fruit
- Less than one serve/day
- 1 serve/day
- 2 serves/day
- 3 serves/day
- 4 serves/day
- 5 serves/day
- 6 serves or more/day

QB5 About how many slices of bread do you usually eat per day? (a bread roll counts as two slices of bread) (Please shade one response only)

- I don’t eat bread
- Less than one slice/day
- 1 slice/day
- 2 slices/day
- 3 slices/day
- 4 slices/day
- 5-7 slices/day
- 8 slices or more/day

QB6 What type of bread do you usually eat? (Please shade any that you usually eat)

- I don’t eat bread
- High fibre white bread
- White bread
- Wholemeal bread
- Rye bread
- Multigrain bread
- Other bread

QB7 About how many days per week do you usually have something to eat for breakfast?
(Please shade one response only)

- Rarely/never
- 1-2 days/week
- 3-4 days/week
- 5 days or more/week
**QB8**  About how often is the meat you eat trimmed of fat either before or after cooking?  
(Please shade one response only)  

<table>
<thead>
<tr>
<th></th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
</tr>
</thead>
<tbody>
<tr>
<td>I don't eat meat</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Never</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rarely</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sometimes</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Usually</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Always</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**QB9**  In the past month, about how often have you had the following?  
(Please circle one response on each line)  

<table>
<thead>
<tr>
<th>Food Type</th>
<th>Never or less than once/month</th>
<th>1-3 times a month</th>
<th>1-2 times a month</th>
<th>2-3 times a month</th>
<th>3-4 times a month</th>
<th>4-5 times a month</th>
<th>6 or more times a month</th>
</tr>
</thead>
<tbody>
<tr>
<td>Potato crisps or salty snack foods</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chocolate or lollies</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cake, doughnuts, sweet biscuits</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pies, pasties or sausage rolls</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fast foods (e.g. McDonalds, KFC)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pizza</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Red meat (beef, lamb or pork as chops, steaks, roasts, stir fries, casserole, rissoles, mince)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
In the past month, about how often have you had the following?
(Please circle one response on each line)

<table>
<thead>
<tr>
<th>Food Type</th>
<th>Never or less than once/month</th>
<th>1-3 times a month</th>
<th>Once/week</th>
<th>2-4 times/week</th>
<th>5-6 times/week</th>
<th>Once a day</th>
<th>2-3 times a day</th>
<th>4-5 times a day</th>
<th>6 or more times a day</th>
</tr>
</thead>
<tbody>
<tr>
<td>Meat products (e.g. sausages, frankfurter)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chicken (not counting crumbed or fast foods like KFC)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fish including tinned fish (but not fried fish)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dried beans/peas (e.g. baked beans, lentils)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Eggs</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nuts</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cheese</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yoghurt</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pasta, rice, noodles</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Breakfast cereal (ready-made, home-made or cooked)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

QB10  What type of milk do you usually drink?  (Please shade one response only)

- I don’t drink milk  
- Whole  
- Skim  
- Low/reduced fat  
- Soy  
- Don’t know
QB11  About how many serves of PLAIN milk in total do you usually drink each day? (i.e. do NOT count chocolate milk or other flavoured milk)  (1 serve = 125ml or ½ cup/glass)  (Please shade one response only)

1. I don’t drink plain milk  
2. Less than 1 serve/day  
3. 1 serve/day  
4. 2 serves/day  
5. 3 serves/day  
6. 4-5 serves/day  
7. 6-7 serves/day  
8. 8-9 serves/day  
9. 10 or more serves/day

QB12  About how much FLAVOURED milk in total do you usually drink each day?  (e.g. chocolate milk or other flavoured or sweetened milk)  (Please shade one response only)  
1 serve = 125ml or ½ cup/glass; 600 ml bottle/carton = 5 serves)

1. I don’t drink flavoured milk  
2. Less than 1 serve/day  
3. 1 serve/day  
4. 2 serves/day  
5. 3 serves/day  
6. 4-5 serves/day  
7. 6-7 serves/day  
8. 8-9 serves/day  
9. 10 or more serves/day

QB13  About how much WATER in total do you usually drink each day?  
(Please shade one response only)  (1 serve = 125ml or ½ cup/glass; 600ml=5 serves; 1 litre bottle=8 serves)

1. I don’t drink water  
2. Less than 1 serve/day  
3. 1 serve/day  
4. 2 serves/day  
5. 3 serves/day  
6. 4-5 serves/day  
7. 6-7 serves/day  
8. 8-9 serves/day  
9. 10 or more serves/day
**QB14** About how much SOFT DRINK (excluding diet soft drink) do you usually drink each day? (include all types of soft drink, including fruit flavoured drinks and sports drinks, but exclude any diet soft drinks, fruit juice or plain water) (Please shade one response only)

(1 serve = 125ml or ½ cup/glass; 1 can = 3 serves; 600 ml bottle = 5 serves; 1.25L bottle = 10 serves)

<table>
<thead>
<tr>
<th>I don’t drink soft drink</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Less than 1 serve/day</td>
<td>2</td>
</tr>
<tr>
<td>1 serve/day</td>
<td>3</td>
</tr>
<tr>
<td>2 serves/day</td>
<td>4</td>
</tr>
<tr>
<td>3 serves/day</td>
<td>5</td>
</tr>
<tr>
<td>4-5 serves/day</td>
<td>6</td>
</tr>
<tr>
<td>6-7 serves/day</td>
<td>7</td>
</tr>
<tr>
<td>8-9 serves/day</td>
<td>8</td>
</tr>
<tr>
<td>10 or more serves/day</td>
<td>9</td>
</tr>
</tbody>
</table>

**QB15** About how much DIET SOFT DRINK do you usually drink each day? (include all types of diet soft drink, including low-calorie fruit flavoured drinks, but exclude any fruit juice or plain water) (Please shade one response only)

(1 serve = 125ml or ½ cup/glass; 1 can = 3 serves; 600 ml bottle = 5 serves; 1.25L bottle = 10 serves)

<table>
<thead>
<tr>
<th>I don’t drink diet soft drink</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Less than 1 serve/day</td>
<td>2</td>
</tr>
<tr>
<td>1 serve/day</td>
<td>3</td>
</tr>
<tr>
<td>2 serves/day</td>
<td>4</td>
</tr>
<tr>
<td>3 serves/day</td>
<td>5</td>
</tr>
<tr>
<td>4-5 serves/day</td>
<td>6</td>
</tr>
<tr>
<td>6-7 serves/day</td>
<td>7</td>
</tr>
<tr>
<td>8-9 serves/day</td>
<td>8</td>
</tr>
<tr>
<td>10 or more serves/day</td>
<td>9</td>
</tr>
</tbody>
</table>
QB16  About how much FRUIT JUICE in total do you usually drink each day?
(1 serve = 125ml or ½ cup/glass or popper/tetra pack) (Please shade one response only)

- I don’t drink fruit juice  
- Less than 1 serve/day  
- 1 serve/day  
- 2 serves/day  
- 3 serves/day  
- 4-5 serves/day  
- 6-7 serves/day  
- 8-9 serves/day  
- 10 or more serves/day

QB17  Over the last 12 months, on days when you were drinking alcohol, about how many glasses of beer, wine and/or spirits altogether did you usually drink?
(Please shade one response only)

You can work out the number of glasses using the examples given below. For spirits, liqueurs, and mixed drinks containing spirits, please count each nip (30mls) as one glass:

- 1 can or stubby of beer = 2 glasses
- 1 large bottle beer (750ml) = 4 glasses
- 1 bottle wine (750mls) = 6 glasses
- 1 bottle of port or sherry (750mls) = 12 glasses
- 1 pre-mixed spirit (275mls) = 2 glasses

<table>
<thead>
<tr>
<th>Total number of glasses per day</th>
</tr>
</thead>
</table>
| 1 glass/day  
| 2 glasses/day  
| 3 glasses/day  
| 4 glasses/day  
| 5 glasses/day  
| 6 glasses/day  
| 7 glasses/day  
| 8 glasses/day  
| 9 glasses/day  
| 10 or more glasses/day  
| I don’t drink alcohol

If you DON’T drink alcohol→skip to question B19
**QB18**  Over the last 12 months, on average how often did you drink beer, wine and/or spirits?  
(Please circle one response on each line)

<table>
<thead>
<tr>
<th>Beverage Type</th>
<th>Never</th>
<th>Less than once/month</th>
<th>1-3 days/month</th>
<th>1 day/week</th>
<th>2 days/week</th>
<th>3 days/week</th>
<th>4 days/week</th>
<th>5 days/week</th>
<th>6 days/week</th>
<th>Every day</th>
</tr>
</thead>
<tbody>
<tr>
<td>Beer (low alcohol)</td>
<td>Never</td>
<td>Less than once/month</td>
<td>1-3 days/month</td>
<td>1 day/week</td>
<td>2 days/week</td>
<td>3 days/week</td>
<td>4 days/week</td>
<td>5 days/week</td>
<td>6 days/week</td>
<td>Every day</td>
</tr>
<tr>
<td>Beer (full alcohol)</td>
<td>Never</td>
<td>Less than once/month</td>
<td>1-3 days/month</td>
<td>1 day/week</td>
<td>2 days/week</td>
<td>3 days/week</td>
<td>4 days/week</td>
<td>5 days/week</td>
<td>6 days/week</td>
<td>Every day</td>
</tr>
<tr>
<td>Red wine</td>
<td>Never</td>
<td>Less than once/month</td>
<td>1-3 days/month</td>
<td>1 day/week</td>
<td>2 days/week</td>
<td>3 days/week</td>
<td>4 days/week</td>
<td>5 days/week</td>
<td>6 days/week</td>
<td>Every day</td>
</tr>
<tr>
<td>White wine (include sparkling wines)</td>
<td>Never</td>
<td>Less than once/month</td>
<td>1-3 days/month</td>
<td>1 day/week</td>
<td>2 days/week</td>
<td>3 days/week</td>
<td>4 days/week</td>
<td>5 days/week</td>
<td>6 days/week</td>
<td>Every day</td>
</tr>
<tr>
<td>Fortified wine, port, sherry etc</td>
<td>Never</td>
<td>Less than once/month</td>
<td>1-3 days/month</td>
<td>1 day/week</td>
<td>2 days/week</td>
<td>3 days/week</td>
<td>4 days/week</td>
<td>5 days/week</td>
<td>6 days/week</td>
<td>Every day</td>
</tr>
<tr>
<td>Spirits, liqueurs etc</td>
<td>Never</td>
<td>Less than once/month</td>
<td>1-3 days/month</td>
<td>1 day/week</td>
<td>2 days/week</td>
<td>3 days/week</td>
<td>4 days/week</td>
<td>5 days/week</td>
<td>6 days/week</td>
<td>Every day</td>
</tr>
<tr>
<td>Pre-mixed spirits (i.e. Bacardi Breezer, Lemon Ruski)</td>
<td>Never</td>
<td>Less than once/month</td>
<td>1-3 days/month</td>
<td>1 day/week</td>
<td>2 days/week</td>
<td>3 days/week</td>
<td>4 days/week</td>
<td>5 days/week</td>
<td>6 days/week</td>
<td>Every day</td>
</tr>
</tbody>
</table>

**QB19**  About how often are these foods available in your HOME?  
(Please circle one response on each line)

<table>
<thead>
<tr>
<th>Food Type</th>
<th>Never</th>
<th>Rarely</th>
<th>Sometimes</th>
<th>Usually</th>
<th>Always</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fruit</td>
<td>Never</td>
<td>Rarely</td>
<td>Sometimes</td>
<td>Usually</td>
<td>Always</td>
</tr>
<tr>
<td>Vegetables</td>
<td>Never</td>
<td>Rarely</td>
<td>Sometimes</td>
<td>Usually</td>
<td>Always</td>
</tr>
<tr>
<td>Cakes/doughnuts/biscuits</td>
<td>Never</td>
<td>Rarely</td>
<td>Sometimes</td>
<td>Usually</td>
<td>Always</td>
</tr>
<tr>
<td>Fruit juice</td>
<td>Never</td>
<td>Rarely</td>
<td>Sometimes</td>
<td>Usually</td>
<td>Always</td>
</tr>
<tr>
<td>Potato chips or other salty snack foods</td>
<td>Never</td>
<td>Rarely</td>
<td>Sometimes</td>
<td>Usually</td>
<td>Always</td>
</tr>
<tr>
<td>Chocolate or other lollies</td>
<td>Never</td>
<td>Rarely</td>
<td>Sometimes</td>
<td>Usually</td>
<td>Always</td>
</tr>
<tr>
<td>Soft drink</td>
<td>Never</td>
<td>Rarely</td>
<td>Sometimes</td>
<td>Usually</td>
<td>Always</td>
</tr>
<tr>
<td>Sports drinks or energy drinks</td>
<td>Never</td>
<td>Rarely</td>
<td>Sometimes</td>
<td>Usually</td>
<td>Always</td>
</tr>
</tbody>
</table>
How **confident** are you that you could do the following **over the next year**?  
(Please shade one response on each line.)

<table>
<thead>
<tr>
<th></th>
<th>Not at all confident</th>
<th>Slightly confident</th>
<th>Moderately confident</th>
<th>Very confident</th>
<th>Extremely confident</th>
<th>Not applicable</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. Shop regularly for healthy nutritious foods</td>
<td>O</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>b. Prepare/cook healthy nutritious foods</td>
<td>O</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>c. Stick to eating healthy nutritious foods</td>
<td>O</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>d. Eat enough fruit for good health</td>
<td>O</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>e. Eat enough vegetables for good health</td>
<td>O</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>f. Limit your fast food consumption to once a week or less</td>
<td>O</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>g. Eat a low-fat diet</td>
<td>O</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>h. Stick to low-fat healthy foods even when you feel depressed, bored or tense</td>
<td>O</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>i. Stick to low-fat healthy foods when you are eating out</td>
<td>O</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>j. Stick to low-fat healthy foods when you are eating at work/place of study</td>
<td>O</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>k. Stick to low-fat healthy foods even when there are high-fat foods available</td>
<td>O</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>l. Stick to low-fat healthy foods even when eating with friends or co-workers</td>
<td>O</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>m. Stick to low-fat healthy foods even when you are alone and there is no one to watch you</td>
<td>O</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>n. Stick to low-fat healthy foods even when you feel too tired or lazy to prepare something healthy</td>
<td>O</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>o. Stick to low-fat healthy foods even when you are craving less healthy foods</td>
<td>O</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
</tbody>
</table>
It is often hard to know which foods are healthy and which are not. The next few questions are about choosing foods.

For example, suppose you were asked “If a person wanted to cut down on fat, which cheese would be best to eat?”

Cheddar cheese
Camembert
Cream cheese
Cottage cheese

If you thought cottage cheese was the right answer, even though you may not like it, you would still shade cottage cheese.

**QB21** In your view, which one of the following would be the best choice for a low fat, high fibre light meal? (Please shade one response only)

Grilled chicken
Cheddar cheese on wholemeal toast
Baked beans on wholemeal toast
Quiche
I don’t know

**QB22** In your view, which kind of sandwich do you think is the lower kilojoule (calorie) choice? (Please shade one response only)

One made of two thick slices of bread with a thin slice of cheddar cheese
One made of two thin slices of bread with a thick slice of cheddar cheese
I don’t know

**QB23** Many people eat spaghetti Bolognese (pasta with a tomato and meat sauce). In your view, which one of the following do you think is the lower fat option? (Please shade one response only)

A large amount of pasta with a small amount of meat sauce
A small amount of pasta with a large amount of meat sauce
I don’t know
QB24 If a person wanted to reduce the amount of fat in their diet, but didn't want to give up hot chips, which one of the following do you think would be the best choice? (Please shade one response only)

<table>
<thead>
<tr>
<th>Option</th>
<th>1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thick cut chips</td>
<td></td>
</tr>
<tr>
<td>Thin cut chips</td>
<td></td>
</tr>
<tr>
<td>Crinkly cut chips</td>
<td></td>
</tr>
<tr>
<td>I don’t know</td>
<td></td>
</tr>
</tbody>
</table>

QB25 If a person felt like something sweet, but was trying to cut down on sugar, which one of the following do you think would be the best choice? (Please shade one response only)

<table>
<thead>
<tr>
<th>Option</th>
<th>1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Honey on toast</td>
<td></td>
</tr>
<tr>
<td>A cereal snack bar</td>
<td></td>
</tr>
<tr>
<td>A plain sweet biscuit (e.g. Marie biscuit or Arrowroot or Digestive)</td>
<td></td>
</tr>
<tr>
<td>Banana with plain yoghurt</td>
<td></td>
</tr>
<tr>
<td>I don’t know</td>
<td></td>
</tr>
</tbody>
</table>

QB26 In your view, which one of the following would be the best choice for a low kilojoule (calorie) dessert? (Please shade one response only)

<table>
<thead>
<tr>
<th>Option</th>
<th>1</th>
</tr>
</thead>
<tbody>
<tr>
<td>A small bowl of stewed fruit</td>
<td></td>
</tr>
<tr>
<td>A small tub of regular strawberry yoghurt</td>
<td></td>
</tr>
<tr>
<td>2 wholemeal biscuits with cheddar cheese</td>
<td></td>
</tr>
<tr>
<td>A slice of carrot cake with cream cheese topping</td>
<td></td>
</tr>
<tr>
<td>I don’t know</td>
<td></td>
</tr>
</tbody>
</table>

QB27 In your view, which one of the following would be the best choice for a low kilojoule (calorie) drink? (Please shade one response only)

<table>
<thead>
<tr>
<th>Option</th>
<th>1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Soft-drink</td>
<td></td>
</tr>
<tr>
<td>Cordial</td>
<td></td>
</tr>
<tr>
<td>Fruit juice</td>
<td></td>
</tr>
<tr>
<td>Diet cordial or diet soft-drink</td>
<td></td>
</tr>
<tr>
<td>I don’t know</td>
<td></td>
</tr>
</tbody>
</table>
SECTION C: ABOUT YOU

QC1 How much do you currently weigh without clothes or shoes?

_____ kg or ____ pounds

QC2 Looking at your baby’s Child Health Record (blue book), please copy figures for the most recent weight, height and head circumference measurement into the table below.

<table>
<thead>
<tr>
<th>Date measured</th>
<th>Weight (g)</th>
<th>Height(cm)</th>
<th>Head circumference (cm)</th>
</tr>
</thead>
<tbody>
<tr>
<td><em><strong>/</strong></em>/_____</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

QC3 Did you plan your first pregnancy? (Please shade one response only)

Yes ☐
No ☐

QC4 Are you currently pregnant? (Please shade one response only)

Yes ☐
No ☐

QC5 Are you planning to become pregnant in the next 3 – 6 months? (Please shade one response only)

Yes ☐
No ☐
Not sure ☐

Thank you for completing the survey!

Please bring this survey with you to your next INFANT session scheduled in approximately 2 weeks. If you cannot make it to the next session please post the survey to the INFANT research team using the replied paid envelope provided.
Appendix 7

mums OnLiNE intervention

Diet and physical activity self-efficacy questions
QG1  How confident are you that you could do the following over the next year? (Please shade one response on each line.)
Not at all confident  Slightly confident  Moderately confident  Very confident  Extremely confident  Not applicable

<p>| | | | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>a. Shop regularly for healthy nutritious foods</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>b. Prepare/cook healthy nutritious foods</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>c. Stick to eating healthy nutritious foods</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>d. Eat enough fruit for good health</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>e. Eat enough vegetables for good health</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>f. Limit your fast food consumption to once a week or less</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>g. Eat a low-fat diet</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>h. Stick to low-fat healthy foods even when you feel depressed, bored or tense</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>i. Stick to low-fat healthy foods when you are eating out</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>j. Stick to low-fat healthy foods when you are eating at work/place of study</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>k. Stick to low-fat healthy foods even when there are high-fat foods available</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>l. Stick to low-fat healthy foods even when eating with friends or co-workers</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>m. Stick to low-fat healthy foods even when you are alone and there is no one to watch you</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>n. Stick to low-fat healthy foods even when you feel too tired or lazy to prepare something healthy</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>o. Stick to low-fat healthy foods even when you are craving less healthy foods</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
1. Stick to low-fat healthy foods even when eating with friends or co-workers

<p>| | | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>O₁</td>
<td>O₂</td>
<td>O₃</td>
<td>O₄</td>
<td>O₅</td>
</tr>
</tbody>
</table>

m. Stick to low-fat healthy foods even when you are alone and there is no one to watch you

<p>| | | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>O₁</td>
<td>O₂</td>
<td>O₃</td>
<td>O₄</td>
<td>O₅</td>
</tr>
</tbody>
</table>

n. Stick to low-fat healthy foods even when you feel too tired or lazy to prepare something healthy

<p>| | | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>O₁</td>
<td>O₂</td>
<td>O₃</td>
<td>O₄</td>
<td>O₅</td>
</tr>
</tbody>
</table>

o. Stick to low-fat healthy foods even when you are craving less healthy foods

<p>| | | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>O₁</td>
<td>O₂</td>
<td>O₃</td>
<td>O₄</td>
<td>O₅</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Not at all confident</th>
<th>Slightly confident</th>
<th>Moderately confident</th>
<th>Very confident</th>
<th>Extremely confident</th>
<th>Not applicable</th>
</tr>
</thead>
</table>
QG2 How confident are you that you could do physical activity, in each of the following situations, over the next year? (Please shade one response on each line.)

<table>
<thead>
<tr>
<th>Situation</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. Do physical activity when I am tired</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>b. Do physical activity when I am in a bad mood</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>c. Do physical activity when I don’t have time</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>d. Do physical activity when I am on holiday</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>e. Do physical activity when it is raining</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
</tbody>
</table>