RESEARCH PAPER

Trial for Reducing Weight Retention in New Mums: a randomised controlled trial evaluating a low intensity, postpartum weight management programme

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Abstract

Background: Failure to return to pregnancy weight by 6 months postpartum is associated with long-term obesity, as well as adverse health outcomes. This research evaluated a postpartum weight management programme for women with a body mass index (BMI) > 25 kg m⁻² that combined behaviour change principles and a low-intensity delivery format with postpartum nutrition information.

Methods: Women were randomised at 24–28 weeks to control (supported care; SC) or intervention (enhanced care; EC) groups, stratified by BMI cohort. At 36 weeks of gestation, SC women received a ‘nutrition for breastfeeding’ resource and EC women received a nutrition assessment and goal-setting session about post-natal nutrition, plus a 6-month correspondence intervention requiring return of self-monitoring sheets. Weight change, anthropometry, diet, physical activity, breastfeeding, fasting glucose and insulin measures were assessed at 6 weeks and 6 months postpartum.

Results: Seventy-seven percent (40 EC and 41 SC) of the 105 women approached were recruited; 36 EC and 35 SC women received a programme and 66.7% and 48.6% completed the study, respectively. No significant differences were observed between any outcomes. Median [interquartile range (IQR)] weight change was EC: −1.1 (9.5) kg versus SC: −1.1 (7.5) kg (6 weeks to 6 months) and EC: +1.0 (8.7) kg versus SC: +2.3 (9) kg (pre-pregnancy to 6 months). Intervention women breastfed for half a month longer than control women (180 versus 164 days; P = 0.10). An average of 2.3 out of six activity sheets per participant was returned.

Conclusions: Despite low intervention engagement, the high retention rate suggests this remains an area of interest to women. Future strategies must facilitate women’s engagement, be individually tailored, and include features that support behaviour change to decrease women’s risk of chronic health issues.

Introduction

Increasing rates of overweight and obesity appear to be more pronounced in women (Thorburn, 2005), with pregnancy-related weight gain having previously been identified as a potential, major contributor to higher rates of overweight and obesity in women of reproductive age (van der Pligt et al., 2013). Maternal obesity during pregnancy is associated with increased risks of gestational diabetes mellitus, hypertension, birth defects, increased...
caesarean sections and longer hospital stays (Callaway et al., 2006; Galtier et al., 2008; McIntyre et al., 2012). In addition, offspring born to obese mothers are predisposed to multiple, serious adverse health outcomes both in the short term (Cedergren & Källén, 2003; Cedergren & Källén, 2005; Rankin et al., 2010; Watkins et al., 2003) and long term (Drake & Reynolds, 2010).

Historically, the postpartum period is defined as up to 6 weeks post-delivery, although it has been described up to 1 year as a result of other pregnancy-related physiological events/changes that occur over this period (e.g. breastfeeding) (Amorim et al., 2007). Although weight retention appears to be variable, increased body mass index (BMI) from one pregnancy to the next is associated with increased risk of multiple, serious obstetric (Wolfe & Gross, 1994; Edwards et al., 1996; Lu et al., 2001; Sebire et al., 2001; Roberts & Lain, 2002; O’Brien et al., 2003; Kuhlmann et al., 2008; Ramachenderan et al., 2008; Addo, 2011; Dodd et al., 2011) and neonatal outcomes (Lucas et al., 1988; Cedergren & Källén, 2003, 2005; Watkins et al., 2003; Chu et al., 2007; Rankin et al., 2010; Ruager-Martín et al., 2010; Tennant et al., 2011) during subsequent pregnancies. Moreover, failure to lose pregnancy weight by 6 months postpartum has been shown to be a significant predictor of long-term obesity (Rooney & Schauberger, 2002; Linné et al., 2003; Mamun et al., 2010) and, by the end of the first year postpartum, weight retention has been found to predict maternal overweight 15 years later (Linné et al., 2004).

Alongside the development of long-term obesity, postpartum weight retention has been shown to contribute to obesity-related chronic disease, as well as associated personal, health and financial burdens (Gunderson, 2009). Of concern is that maternal weight tends to be centrally rather than peripherally deposited (Keppel & Taffel, 1993; Gunderson et al., 2004; Taveras et al., 2010; Althuizen et al., 2011), increasing the risk for development of maternal cardiovascular disease (Smith et al., 1994; Gunderson et al., 2004; Taveras et al., 2010; van der Pligt et al., 2013).

Recently published antenatal weight management studies have reported varying success (Streuling et al., 2010; Tanentsapf et al., 2011; Oteng-Ntim et al., 2012) and many women find it difficult to regulate or restrict their gestational weight gain (GWG). Women who start pregnancy with a BMI in the overweight or obese range are more likely to gain weight in excess of their recommended range in excess of their recommended range (Gunderson, 2009), based on the most recent Institute of Medicine (IOM) guidelines for healthy GWG (Institute of Medicine, 2009). Furthermore, it has been suggested that weight retention can be exaggerated by an energy imbalance in the postpartum period. The energy imbalance can result from excess dietary intake, reduction of energy expenditure or a combination of both behaviours (Amorim et al., 2007).

Limited literature exists regarding the most effective approach for weight management postpartum. However, intervention studies that have utilised a combination of both diet and physical activity components have been shown to be more successful than otherwise (Amorim et al., 2007; van der Pligt et al., 2013). Few interventions targeting postpartum weight retention have been underpinned by behavioural change theories (Kinnunen et al., 2007; Østbye et al., 2009; van der Pligt et al., 2013), which is surprising because successful weight loss interventions have previously employed key elements of the social cognitive theory (SCT) in their design (Tate et al., 2001; Morgan et al., 2009; Khaylis et al., 2010; Shapiro et al., 2012) in non-obstetric populations and is recognised as essential in broader health psychology literature (Michie et al., 2008).

Although data regarding the most effective methods of supporting weight loss following pregnancy are lacking (Amorim et al., 2007), postpartum weight loss is achievable, although many uncertainties remain as to the optimal delivery method and recruitment stage for effective results (van der Pligt et al., 2013). Interestingly, very few studies have recruited women during pregnancy with intervention delivery continuing throughout the remainder of pregnancy and beyond childbirth. One recent study conducted by Huang et al. (2011) compared two intervention groups: one recruited at 16 weeks of gestation and the other between 24–48 h after labour (Huang et al., 2011). Weight loss was achieved in the group recruited during pregnancy but not in the group recruited following childbirth (Huang et al., 2011).

Despite factors such as socio-economic status, parity and high prepregnancy BMI having previously been associated with postpartum weight retention, by far the strongest predictor of postpartum weight retention is excessive GWG (Greene et al., 1988; Crowell, 1995; Walker, 1996; Linné & Neovius, 2006). Therefore, provision of support across the perinatal period is vital to not only assist healthy GWG, but also to promote healthy weight attainment following pregnancy.

Although a recent Cochrane review reported that there is no clear definition of ‘excess’ weight retention and/or a time within which women should return to their prepregnancy weight (Amorim et al., 2007), the postpartum period presents as a key public health consideration for the delivery of weight-focused interventions in a population particularly vulnerable to excessive weight gain.

As such, our research aim was to develop, implement and evaluate an innovative postpartum weight management programme that included evidence-based behaviour
change strategies to support postpartum weight management, delivered in a format suitable for women attending our hospital, informed by our earlier study that explored practical strategies to best provide maternal post-natal education (Wilkinson & Tolcher, 2010). More specifically, we developed, implemented, and evaluated a programme (‘Nutrition for New Mums’; NFNM), as part of the TRiM study – Trial to Reduce Weight Retention in New Mums – that adopted and combined successful weight loss/behaviour change principles (self-monitoring), an innovative low-intensity delivery format (postal correspondence), with evidence-based postpartum nutrition information, recognising women’s needs and interests, to decrease their risk of obesity and chronic disease. Our primary hypothesis was that weight loss for women in the intervention group would be statistically significantly greater at 6 months postpartum by 3 kg. Our secondary hypotheses were that, compared to women in the control group, women in the intervention group would: (i) retain significantly less weight; (ii) have significantly better diet quality; (iii) undertake significantly more minutes of physical activity; (iv) demonstrate significantly higher breastfeeding rates; (v) have significantly lower fasting glucose, insulin and Homeostatic Model Assessment (HOMA-IR) estimates of insulin resistance; as well as (vi) significantly lower fat mass (FM) and significantly higher fat free mass (FFM).

Materials and methods

Design and participants

The postpartum weight management correspondence intervention used a stratified randomised controlled design. Women were eligible if they had a prepregnancy BMI > 25 kg m⁻², could read and speak English to a level that allowed completion of intervention worksheets, and were older than 18 years (or younger than 18 years, with the consent of a parent or guardian). Women were ineligible if they lived outside the hospital’s catchment area, delivered before 36 weeks of pregnancy, had a prepregnancy diagnosis of type 1 or type 2 diabetes mellitus, had a history of substance use or had a severe medical or psychological diagnosis that prevented participation within the intervention. Randomisation was stratified according to BMI group (25–30 kg m⁻²; >30 kg m⁻²). This study was approved by the Mater Health Services Human Research Ethics Committee.

Thirty-four women per group were required to detect hypothesised difference in weight between groups, based on previous research for intervention effects [intervention: mean (SD) −7.8 (4.5) kg versus control: mean (SD) −4.9 (5.4) kg in predominately multiparous], overweight (pregnant) population (Leermakers et al., 1998), with 80% power and α set at 0.05, requiring 68 women to be recruited in total. Allowing for an attrition rate of 20%, approximately 88 women needed to be recruited to be able to detect the between group difference in weight change over time.

Procedures

Recruitment ran from 31 August 2010 until 7 July 2011. Eligible women were identified by the research midwife by reviewing the hospital clinic lists and hospital database that contained women’s BMIs; opportunistic recruitment occurred through clinic obstetricians, midwives, diabetes educators and dietitians who were aware of study eligibility criteria. Advertisements were displayed in the antenatal clinic from the launch of the trial. Names of interested women were provided to the research midwife who made contact with the women.

Women were approached at their 24th or 28th week antenatal clinic appointment (when women were attending for their oral glucose tolerance test) and those who provided informed consent after receiving information about the study were enrolled. Women who expressed interest earlier in their pregnancies had their names recorded and were contacted closer to the end of the second trimester. Women identified later than 28 weeks were also eligible for recruitment, up until approximately 36 weeks. Rolling recruitment occurred until 88 women were recruited and took almost 12 months.

The study was explained as a trial evaluating different handouts to support healthy lifestyles and weight loss after pregnancy, with three data collection points. Following consent, women were randomised to the control (‘supported care’; SC) or intervention (‘enhanced care’; EC) group, stratified by BMI cohort. The computerised randomisation process was managed by the hospital’s research support unit; allocation was concealed using sealed opaque envelopes and the research midwife was blinded to trial group. Following consent, women’s details were provided to the research dietitian (SW) who contacted them to organise their appointment (data collection 1 and programme education) to coincide with their pre-existing week 36 hospital visit. Upon completion of the study, all participants were provided with $AU20 (12) department store shopping vouchers and were offered the opportunity of an individual consultation with a dietitian at the end of the 6-month intervention.

Programmes

At the 36-week hospital visit, members of the control group (SC) were provided with a ‘Healthy Eating for Breastfeeding’ sheet based on the National Dietary...
Guidelines for women breastfeeding that were current at the time of the study (NHMRC, 2003). Members of the intervention group (EC) received a 6-month correspondence intervention designed according to SCT (Michie et al., 2008) that involved a 1-h face-to-face nutrition assessment, goal-setting introduction and counselling session regarding nutrition post-pregnancy (delivered antenatally at approximately 36 weeks), which was in line with the Australian Dietary Guidelines (NHMRC, 2003), and fortnightly information and goal-setting sheets posted from 6 weeks until 3 months postpartum, and then monthly information and goal-setting sheets posted until 6 months postpartum. Content combined successful weight loss/behaviour change principles (self-monitoring), a low-intensity delivery format (postal correspondence), with evidence-based postpartum nutrition information, recognising women’s needs and interests, to decrease their risk of obesity and chronic disease. The research dietitian (SW) delivered the initial programme to both groups and experienced hospital-based dietitians delivered the postal intervention. An overview of the programme content and timing of the correspondence is outlined in Fig. 1.

In a previous study by this hospital’s nutrition and dietetic service (Wilkinson & Tolcher, 2010), a large proportion of women surveyed rated the importance of eating well post-natally as being important or very important (92%) and returning to their prepregnancy weight as important or very important (67%). One half were interested in post-natal education and support, either as an inpatient or at a community consultation. The main topics of interest were healthy nutrition for the post-natal period, breastfeeding, weight loss support, ideas for quick, nutritious meals and introducing solids. This feedback informed the delivery method and content design of the programme. Content was designed to build health behaviour self-efficacy, an element of SCT. From the literature, effective strategies to achieve this in written health information include providing positive reinforcements, using peer quotes for modelling, structuring tasks to allow early mastery of behaviours, addressing barriers to performing a behaviour, and prompting (Paul et al., 2004). To formulate content for worksheets, the research dietitian (with psychology qualifications) (SW) used previous (S. Wilkinson, unpublished data) provided from a convenience sample of 20 post-natal women from the study hospital who were asked ‘what do you know now that you wish you knew then…?’ about the topics of interest listed above, as well as sleep, balancing family and friends, being a new mum, and physical activity. Content was reviewed by an expert panel from the hospital’s senior physiotherapist, lactation consultants, midwives, dietitians and consumers.

Data collection and outcome measures

Both groups completed data collection and received parking vouchers following all consultations. Data collection occurred at three time points; time one = 56 weeks of pregnancy; time two = 6 weeks postpartum (6/52); time three = 6 months postpartum (6/12). At time one, data collected included: weight, height, prepregnancy weight (self-reported), diet quality [fat and fibre behaviour index (FFB)] (Reeves et al., 2010), physical activity (Australian Women’s Activity Survey) (Fjeldsoe et al., 2009b), ‘Breastfeeding Intention’ (Nommsen-Rivers & Dewey, 2009), classifying women’s intention to breastfeed to 6-months based from a valid algorithm calculated from responses from five questions about breastfeeding behaviours rated from 0 (no intention to breastfeed) to 16 (very strong intentions to fully breastfeed for 6 months), and an oral glucose tolerance test (from the 28-week visit). Data collected at times two and three included weight, body composition (FFM and FM), blood tests (for fasting insulin and glucose), diet quality, physical activity and breastfeeding status scores (Webb et al., 2001). Length of time breastfeeding was collected as months, weeks and days and then converted to days by taking the sum of days, weeks multiplied by 7, and months multiplied by 30. Total time spent in health enhancing physical activity (HEPA) was reported as a HEPA score (minutes of physical activity week−1). This was calculated by summing data from the intensity levels that are widely accepted as sufficient to confer health benefit (i.e. brisk walking, moderate- and vigorous-intensity activity reported in the planned activity or transport domains). This HEPA total is consistent with recommendations for treating data collected using other existing self-report measures (i.e. Active Australia Survey, Behavioral Risk Factor Surveillance System physical activity module, International Physical Activity Questionnaire) (Fjeldsoe et al., 2009b). HOMA-IR, a widely used estimate of insulin resistance in the fasting state, was calculated as [fasting plasma insulin (mU/L) × fasting plasma glucose (mM)/22.5] (Wallace et al., 2004).

Weight was measured to the nearest 0.1 kg using a spring balance scale. Height was measured with a wall-mounted stadiometer to the nearest 0.5 cm. Body composition was determined using a multi-frequency bioelectrical impedance analyser (Bodystat©1500; BodyStat Ltd., Douglas, Isle of Man, UK) with a measured resistance at a fixed frequency of 50 Hz. Women were advised to fast from 22.00 h the night before, to have no alcohol 24 h before the test and no exercise 4 h before the test. We collected self-reported data using pen-and-paper surveys. We used valid and reliable self-report measures of the health behaviours of interest. Pregnancy history and demographic information were also collected. Hospital
Pathology staff collected blood samples and fasting plasma insulin and glucose were assayed using routine laboratory techniques. The primary outcome measure was weight loss and was calculated as the difference in weight change between EC and SC groups from (i) 6 weeks to 6 months postpartum and (ii) prepregnancy weight to 6 months postpartum. Secondary outcome measures were diet quality scores, minutes of HEPA, proportion of women breastfeeding, fasting glucose and fasting insulin levels, and body composition (FM and FFM).

Figure 1 Outline of the Nutrition for New Mums programme (intervention): time points and content discussed (36 weeks) or posted (remainder).
Data management and analysis

Intention-to-treat analyses were used to examine change in behaviours over time between groups. Change variables were calculated for all behaviours. Absolute differences from times two and three (and time one to three for weight and BMI change) were calculated for continuous variables. Categorical variables were constructed reflecting proportion of women who met fruit, vegetable and breastfeeding guidelines at each time point, and subsequently transformed to a variable classifying whether women continued to meet or not meet guidelines. Continuous measures were checked for normality using visual inspection of histograms and the Shapiro–Wilk test and, in the majority of circumstances, were not normally distributed. Differences in change variables between groups were therefore primarily analysed with Mann–Whitney U-tests, and also chi-squared tests (or Fisher’s exact test for variables with small cell counts). For selected outcome measures, further exploratory analysis was undertaken adjusting for maternal age as there was a significant clinical difference at baseline; however, these analyses did not alter the findings and are not reported.

Results

Participants

Demographic and anthropometric characteristics of the study participants are presented in Table 1. Women tended to be in their late 20s to early 30s, with one-third being in the overweight and two-thirds in the obese BMI category. The majority were married or in de facto relationships, were having their first baby, and reported a high intention to breastfeed. One-third of the cohort had completed high school, one-third had obtained a diploma or trade and one-third had received a university education.

Eighty-one (40 EC and 41 SC; 77.1%) of the 105 women approached were recruited (Fig. 2). One EC participant was excluded for ineligibility (type 1 diabetes) and nine (3 EC and 6 SC) withdrew prior to the intervention for reasons outlined in Fig. 2. Thirty-six EC and 35 SC women attended the 36-week gestation appointment. Reflecting attendance at data collection appointments, full data sets (i.e. data collected at times one, two and three) were obtained for 36.6% SC (n = 13) and 57.5% EC (n = 23) women. Additionally, data were collected at times one and two for 12.2% SC (n = 5) and 2.5% EC (n = 1) women, at times one and three for 4.9% SC (n = 2) and 2.5% EC (n = 1) women, and only at time one for 31.7% SC (n = 13) and 27.5% EC (n = 11) women. All 66.7% of EC women attended both 6-week and 6-month data collection appointments, whereas 60% and 48.6% of SC women attending these appointments, respectively. All programme intervention sheets were posted to the EC participants; 1 BMI > 25 kg m⁻² and 6 BMI > 30 kg m⁻² returned a proportion of their self-monitoring sheets for feedback and 2.3 self-monitoring sheets on average (of six posted) were returned.

Weight loss

No significant differences were observed between the primary outcome measure of weight loss from prepregnancy
to 6 months postpartum for either the intervention group or the control group, or from 6 weeks to 6 months postpartum for either group (Table 2). As a result of the low numbers of data collected at various time points, the study was underpowered to detect this change. The median weight change for the entire cohort from prepregnancy to 6-months postpartum was 1.0 kg and –1.1 kg from 6 weeks to 6 months postpartum.

Secondary outcomes
No significant differences were observed for secondary outcomes. Clinically significant trends (i.e. those that would be considered beneficial in clinical practice) were identified for dietary outcomes, as well as HOMA-index scores. However, the study was underpowered to detect statistical significance.

Figure 2 Overview of study recruitment and retention. EC, enhanced care; SC, supported care; IUFD, intrauterine foetal death; T1DM, type 1 diabetes mellitus.
At 6 weeks postpartum, waist circumference measures were, on average, lower for women in the EC group (106 cm) compared to women in the SC group (111 cm; Table 2). From 6 weeks to 6 months postpartum, waist circumference did not change for the EC women (106 cm) but decreased in the SC group, from 111 to 102 cm. There was no significant difference in change over time between groups for percentage FM or FFM or diet quality outcomes were shown, the intervention did not detect changes in weight loss between the intervention group (EC) and the control group (SC). Other interventions initiated in early pregnancy and which were followed through until the postpartum period have been shown to be successful in limiting postpartum weight retention (Claesson et al., 2011; Huang et al., 2011). Both of these interventions included a greater number of face-to-face counselling sessions compared to one face-to-face session included as part of the NFNM programme. The study conducted by Huang et al. (2011) utilised six counselling sessions from approximately 16 weeks of gestation until 6 months postpartum and Claesson et al. (2011) included weekly individual sessions throughout breastfed for half a month longer than SC women (180 days versus 164 days; \( P = 0.10 \)) (Fig. 5).

### Discussion

The present study evaluated the development and implementation of a woman-focused postpartum weight programme and, although promising results for some health and diet quality outcomes were shown, the intervention did not detect changes in weight loss between the intervention group (EC) and the control group (SC). Other interventions initiated in early pregnancy and which were followed through until the postpartum period have been shown to be successful in limiting postpartum weight retention (Claesson et al., 2011; Huang et al., 2011). Both of these interventions included a greater number of face-to-face counselling sessions compared to one face-to-face session included as part of the NFNM programme. The study conducted by Huang et al. (2011) utilised six counselling sessions from approximately 16 weeks of gestation until 6 months postpartum and Claesson et al. (2011) included weekly individual sessions throughout

### Table 2

Anthropometric and clinical outcomes of the intervention and control samples (6 weeks and 6 months postpartum) and changes over time.

<table>
<thead>
<tr>
<th>Variables</th>
<th>6 weeks postpartum</th>
<th>6 months postpartum</th>
<th>Change (6 weeks to 6 months, unless indicated)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Enhanced care sample</td>
<td>Standard care sample</td>
<td>Enhanced care sample</td>
</tr>
<tr>
<td>Weight (kg)*</td>
<td>92.4 (20.9)</td>
<td>96.8 (18.5)</td>
<td>91.5 (27.1)</td>
</tr>
<tr>
<td>Change: Prepregnancy to 6 months postpartum</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Change: 6 weeks to 6 months postpartum</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Body mass index (kg m(^{-2}))</td>
<td>32.9 (8.7)</td>
<td>32.9 (2.9)</td>
<td>32.7 (7.5)</td>
</tr>
<tr>
<td>Overweight (25–29.9)</td>
<td>8 (3)</td>
<td>3 (1)</td>
<td>8 (3)</td>
</tr>
<tr>
<td>Obese (≥30)</td>
<td>39 (14)</td>
<td>46 (16)</td>
<td>42 (15)</td>
</tr>
<tr>
<td>Change: prepregnancy to 6 months postpartum</td>
<td>53 (19)</td>
<td>51 (18)</td>
<td>50 (18)</td>
</tr>
<tr>
<td>Change: 6 weeks to 6 months postpartum</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Waist circumference (cm)*</td>
<td>106 (14.5)</td>
<td>111 (16.0)</td>
<td>106 (20)</td>
</tr>
<tr>
<td>Percentage fat mass</td>
<td>42.5 (4.9)</td>
<td>41.9 (4.5)</td>
<td>42.1 (5.0)</td>
</tr>
<tr>
<td>Percentage fat free mass</td>
<td>54.0 (7.5)</td>
<td>55.4 (5.9)</td>
<td>53.6 (7.3)</td>
</tr>
<tr>
<td>Fasting insulin*</td>
<td>7.7 (5.4)</td>
<td>9.1 (6.5)</td>
<td>9.1 (6.9)</td>
</tr>
<tr>
<td>Fasting glucose*</td>
<td>4.4 (0.5)</td>
<td>4.5 (0.6)</td>
<td>4.7 (0.9)</td>
</tr>
<tr>
<td>HOMA*</td>
<td>1.4 (1.2)</td>
<td>1.7 (1.8)</td>
<td>1.8 (1.8)</td>
</tr>
<tr>
<td>HEPA (min week(^{-1}))</td>
<td>0 (112.5)</td>
<td>90 (225)</td>
<td>95 (300)</td>
</tr>
</tbody>
</table>

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*Median (interquartile range).

1Percentage (n).

2Mean (SD).  

HEPA, health enhancing physical activity; HOMA, Homeostatic Model Assessment.
Figure 3 Fat and fibre index (total, fat, and fibre) scale scores at 6 weeks and 6 months in the intervention (enhanced care) and control (supported care) arms.

Figure 4 Percentage of women meeting recommended fruit and vegetable serves at 6 weeks and 6 months in the intervention (enhanced care) and control (supported care) arms.

Figure 5 Proportion of women breastfeeding on discharge, at 6 weeks and 6 months in the intervention (enhanced care) and control (supported care) arms.
pregnancy, as well as one session at each of 6, 12, 16 and 24 months postpartum. These findings suggest that
perhaps a more rigorous approach is preferred when
engaging with women about their own health behaviours
following pregnancy and that frequent face-to-face con-
tact might be a successful strategy in motivating women
to make healthy behaviour change.

However, cost-effectiveness of intervention delivery is
an important consideration for an issue that affects a
large proportion of women. Less traditional methods of
participant contact have been shown to be successful, yet
could potentially be less labour intensive and more cost
effective than face-to-face counselling, at the same time as
maintaining broad reach engagement. For example, a
recent study conducted in the USA included an online
‘MyPyramid’ dietary tool combined with provision of
email support to target postpartum weight loss in over-
weight and obese women (Colleran & Lovelady, 2012).
Although a focus of the study was to improve total diet
and food consumption patterns, the intervention was
effective in promoting weight loss compared to minimal
care. Another recent study conducted in Sweden utilised
text messaging support for postpartum weight loss, also
in a sample of overweight and obese women (Bertz et al.,
2012). 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. Alternate effective postpartum programmes,
delivered by short messaging service (SMS) have been
used to increase levels of physical activity (Fjeldsoe et al.,
2009a), smoking cessation (Free et al., 2011) and breast-
feeding (Galglos et al., 2011), with some supported by
face-to-face goal-setting interviews (Fjeldsoe et al.,
2009a). Telephone counselling (i.e. that has a strong theo-
retical behaviour change basis and includes evidence-
based content/information) is also effective in the general
population and may be another avenue appropriate for
this population group (Eakin et al., 2010).

Recruitment difficulties faced in the present study are
consistent with other similar interventions, whereby a low
subject numbers across multiple studies (van der Pligt
et al., 2013) may reflect challenges faced when attempting
to engage women in behaviour change for their own
health benefit, during a time typically focussed on the
health of the unborn child or the newborn in the months
following childbirth. However, once enrolled, many of the
women in the present study remained in the study and
attended the final data collection point. The high reten-
tion rate [particularly for the intervention group (EC)] is
consistent with other studies aimed at limiting post-
partum weight retention (van der Pligt et al., 2013). This
highlights that postpartum weight loss is an area of
interest for motivated women, despite the many adjust-
ments and challenges faced for new mothers in the period
following childbirth.

Regardless of the strategy employed to engage women
during this time, because a large proportion of women
have infrequent contact with healthcare during the post-
partum period with their own health a focus, there is a
need for innovative, broad reach approaches which aim
to address healthy lifestyle behaviours during this impor-
tant life stage. Strategies that address additional barriers,
such as a lack of partner support, mothers returning to
work, difficulties with childcare options and strong social
expectations of the role of a new mother, also need to be
developed (Miller et al., 2002; Watson et al., 2005).

Although the current intervention was not able to pro-
 mote significant postpartum weight loss, health-promoting
dietary changes were apparent. A higher proportion of
women in the intervention group were meeting recommend-
ations for fruit intake at both 6 weeks and 6 months post-
partum compared to women in the control group. Fur-
thermore, sufficient vegetable intake increased from
6 weeks postpartum to 6 months postpartum for women
in the intervention group but decreased for women in the
control group. These results are promising because, when
combined, many studies have shown diet quality to be
suboptimal for women during the postpartum period
(Mackey et al., 1998; Fowles & Walker, 2006; Wiltheiss
et al., 2013) and, although some women might eat more
healthily during pregnancy, they may discontinue these
healthy dietary habits following childbirth, with declines in
both adequate fruit and vegetable intake having been
shown (George et al., 2005; Wiltheiss et al., 2013). Else-
where, dietary patterns in nonpregnant women have been
shown to remain reasonably stable over a 2-year period
(Borland et al., 2007) and, at 6 months postpartum, have
been shown not to change significantly from preconception
or from during pregnancy (Cuco et al., 2005). Therefore,
independent of promoting weight change, promoting fruit
and vegetable intake towards recommendations via a low
intensity intervention might be a successful approach for
supporting mothers with respect to attaining healthy habits
following childbirth.

Interestingly, women in the control group had a greater
waist circumference reduction from 6 weeks to 6 months
compared to the intervention group. This observation is
difficult to interpret within the other trends observed and
warrants further investigation in future studies.

The strengths of the present study were its strong theo-
retical underpinning (SCT, content and delivery meth-
odology, and the inclusion of topics that met women’s
identified needs (Wilkinson & Tolcher, 2010). The study
intervention drew on the design and methodology of
several previous studies, particularly Leermakers et al.

The TRiM randomised controlled trial S. A. Wilkinson et al.
with a mean difference of 0.12 kg week \(^{-1}\) was successful in limiting GWG for overweight women (Jeffries et al., 2009). The intervention did not include a dietary or physical activity focussed 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 one effective strategy to implement as part of future, similar interventions (Lombard et al., 2010).

Surprisingly, few women in the present study returned their self-monitoring sheets for health professional feedback (a key behavioural component of the intervention designed to enhance self-efficacy). One possible reason for this might be that women read and/or completed the activity sheets obtaining the benefit of self-monitoring and feedback regarding personal progress, although they did not feel the need to return the records for health professional feedback. Nonetheless, self-monitoring of weight is an important component of behaviour change (Bandura, 1977; Burke et al., 2011). Planned qualitative semi-structured telephone interviews with women from the intervention group will provide further details on useful programme elements regarding self-monitoring of weight and acceptability of other intervention components.

The main limitation of the present study was the methodological process requiring women to attend the hospital at 6 weeks and 6 months postpartum for blood, anthropometric and health behaviour measurement in a study promoted as a 'low intensity/correspondence intervention'. This need for additional visits likely decreased the completeness of the data set. An additional limitation included the recruitment and delivery of this research during the early 2011 natural disaster of the flooding of Brisbane, which made study participation logistically difficult.

In conclusion, supporting women to achieve a healthy body weight during pregnancy and postpartum is vital for promoting long-term health for women and reducing risk of future obesity and obesity-related disease. Although this intervention was not effective in promoting weight loss and limiting postpartum weight retention in women recruited during pregnancy, the capacity to promote healthy behaviour change is possible in this unique population subgroup. Future studies are needed to investigate effective strategies to support women’s weight management in the postpartum period.

**Conflict of interest, source of funding and authorship**

The authors declare that there are no conflicts of interest.

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All authors have participated sufficiently in the article to take public responsibility for the content. SW (lead author) conceived and developed the study, analysed and interpreted the data and drafted the manuscript. HDMI also conceived and developed the study, assisted with data analysis and interpretation, and provided significant input into the manuscript. PVDP assisted with data interpretation and provided significant input into the manuscript. KG provided high-level statistical support and assistance, including randomisation and study design, data analysis and interpretation, and provided significant input into the manuscript. All authors read and approved the final manuscript submitted for publication.

**References**


