Summary

This systematic review of systematic reviews investigated the effectiveness of lifestyle weight management interventions for postnatal women. We systematically reviewed Medline (PubMed), Embase, CINAHL Plus, The Cochrane Library and Scopus from 2000 until January 2018, to identify systematic reviews of randomised controlled trials that evaluated the effectiveness of behavioural lifestyle interventions for weight management in postnatal women. Results were summarised both descriptively and statistically using a mega meta-analysis of data from randomised controlled trials included in previous systematic reviews. Nine systematic reviews met our inclusion criteria. Overall the reviews concluded that lifestyle interventions involving physical activity and/or dietary changes resulted in a reduction in postnatal weight. Results from the overall mega meta-analysis confirmed this finding with a mean difference of -1.7kg (95% CI -2.3, -1.1). Findings for subgroup analyses gave mean differences of -1.9kg (95% CI -2.9, -1.0) for combined diet and physical activity interventions, -1.6kg (95% CI -2.1, -1.2) for physical activity only interventions, and -9.3kg (95% CI -16.5, -2.1) for diet only interventions (one study). Heterogeneity varied from 0% to 68%. Interventions involving lifestyle interventions appeared to be effective in reducing weight in postnatal women, although these findings should be interpreted with some caution due to statistical heterogeneity.

Introduction

Obesity is a key contributor to many chronic co-morbidities including type 2 diabetes, cardiovascular disease (1), stroke, as well as a number of types of cancers such as colorectal and breast cancer (1-3). These conditions can be life threatening, detrimental to quality of life and expensive to treat.

The obesity epidemic is affecting all populations, including women of reproductive age. Recent national surveys reported that approximately 66%, 56% and 58% of women in the

United States of America, Australia and England, respectively either have overweight (body mass index (BMI) between 25-30kg/m²) or obesity (BMI over 30kg/m²) (4-6). This means that most women already have overweight when they become pregnant. A period of notable weight gain for many women occurs during and after pregnancy (7, 8). Studies have reported that among women who have a healthy BMI prior to pregnancy, 30% have overweight one year after giving birth (9, 10). Of women who have overweight prior to conception, 44% have obesity 1 year after giving birth, while 97% of women with obesity prior to pregnancy remain so at 1 year postnatally. On average women gain about 14-15kg during pregnancy and at 1 year after birth 5-9kg is retained (8, 11). Some women are able to return to their pre-pregnancy weight after childbirth, but the amount of weight women retain postnatally varies considerably and many women never lose all of the weight gained during pregnancy (11, 12-15).

The weight gained, and then retained after pregnancy, tends to be centrally located on the body, which is an independent risk factor for the development of cardio-metabolic diseases such as diabetes and coronary artery disease (16, 17). Additionally, women are at risk of gaining more weight during each successive pregnancy, increasing their likelihood of complications during any future pregnancies, as well as developing obesity in later life (13, 18-19). Evidence also shows an association between postnatal weight and poor mental health, which may adversely affect the behaviour and the family as a whole (20-22). This highlights the need for low cost and acceptable interventions to be designed and tested to help women successfully lose and manage their weight after giving birth. It is not clear which behavioural intervention approaches might be most successful in helping women lose weight, although in non-pregnant population strategies such as goal setting, self-monitoring of weight, calorie counting, attending a commercial weight loss programme, support from a dietician and physical activity have evidence of effectiveness (23, 24).

Objective

Many studies, using a variety of methodological designs, have tested a range of weight-loss interventions during the postnatal period (9, 25). Many of these studies have since been included in systematic reviews of interventions for postnatal weight management. The purpose of this systematic review is to both descriptively and statistically (using a mega meta-analysis) summarise the findings of systematic reviews of randomised controlled trials (RCTs) that have examined the effectiveness of behavioural lifestyle interventions for weight loss in postnatal women.

The aim was to determine whether lifestyle interventions have been successful in helping women lose weight, and if data allow, to further identify which types of interventions have been successful. When several systematic reviews have performed a meta-analysis, a mega meta-analysis is useful because it provides a comprehensive statistical summary of all the evidence. A mega meta-analysis is also useful when previous systematic reviews have not been able to perform meta-analysis or subgroup analyses because of a lack of trials. The results of this systematic review of systematic reviews will help to provide direction and context for the design of future weight management interventions for postnatal women and will contribute to the evidence base for the development of clinical guidelines.

Methods

The protocol for this systematic review of systematic reviews was registered in 2017 in the International Prospective Register of Systematic Reviews (PROSPERO), trial registration number CRD42017072475.

Information sources, search strategy and eligibility criteria for systematic reviews

A comprehensive systematic search of the literature was conducted using the following databases: MEDLINE (PubMed), Embase, CINAHL Plus, The Cochrane Library and Scopus. The search terms used included postnatal, obesity, BMI, diet therapy, physical activity

therapy, body weight, systematic reviews, meta-analyses and derivatives of these search terms. A sample search strategy is shown in the Supplementary Information. Databases were searched from January 2000 to January 2018. We applied this date restriction as it coincided with the introduction of better reporting standards for research, particularly for RCTs and systematic reviews. The criteria for the inclusion and exclusion of systematic reviews are shown in Table 1. In summary, to be eligible for inclusion, systematic reviews had to include RCTs and/or quasi RCTs that had assessed the effectiveness of behavioural lifestyle weight management interventions, namely diet and physical activity interventions or a combination of these, in any format, context and setting, and against any comparator. A wide range of definitions are typically used when referring to the postnatal period, but for the purpose of this systematic review of systematic reviews the postnatal period is defined as used by the authors of the included systematic reviews, which typically starts immediately after childbirth and lasts until 2-3 years after giving birth.

Screening and data extraction

The titles and abstracts of potentially eligible systematic reviews were screened by two independent researchers (JAF, HMP or AJD). When insufficient information was available from the title or abstract, full-text articles were retrieved and considered for inclusion. The full-text articles of potentially eligible systematic reviews were further screened for eligibility by two independent reviewers (JAF and either HMP or AJD) with any disagreements discussed with a third reviewer until consensus reached. Two reviewers independently extracted data from the eligible systematic reviews (JAF and either HMP or AJD) and any disagreements were discussed with a third reviewer until consensus reached. Data extracted for the systematic reviews included author and year of publication, dates of literature search for studies included in the review, participant inclusion criteria, intervention and comparator inclusion criteria, description of studies included in the review, results of any meta-analyses performed, main conclusions of review and any additional comments.

Quality assessment of systematic reviews

The AMSTAR tool (26) was used to assess the quality of the included systematic reviews. This was performed independently by two reviewers (JAF, HMP or AJD) and any disagreements were discussed with a third reviewer until consensus reached. A third reviewer was consulted on two occasions to discuss the scoring of some points on the AMSTAR tool.

Mega meta-analysis

We aimed to statistically summarise weight change data reported in the original RCTs within the included systematic reviews.

For inclusion in the mega meta-analysis, RCTs within the included systematic reviews had to have reported data on body weight in a format that would allow us to perform statistical synthesis. We excluded RCTs that only reported comparisons between two types of diet and/or two physical activity interventions. Trials that had recruited women antenatally, but then offered an intervention postnatally, or which tested interventions that took place both antenatally and postnatally were eligible for inclusion in the mega meta-analysis as long as a postnatal weight had been reported at baseline as well as at follow up (baseline weight used in mega meta-analysis was first reported postnatal weight). Studies that were included in previous systematic reviews that were not RCTs were excluded from the mega meta-analysis. In addition, we excluded interventions shorter than three weeks as these are unlikely to have any longer term impact on weight.

Data were extracted by two independent reviewers (HMP and JAF) with any disagreements referred to a third reviewer (AJD). Review Manager, version 5.3 (27) was used to statistically summarise data from RCTs across all included systematic reviews. Data regarding weight change was summarised using mean difference in weight in kilograms. If this was presented using other metrics, a conversion calculation into kilograms was performed. When trials

126 within reviews only published baseline and follow-up weight data, a weight change calculator
127 (28) was used to calculate the weight change and the associated standard deviations.

128 We expected some heterogeneity due to the variability in the type of interventions tested in
129 RCTs, therefore a random effects model was used in the mega meta-analyses. The I^2 value
130 was calculated as a measure of heterogeneity (29, 30). Subgroup analyses were performed to
131 compare the type of lifestyle intervention (diet only, physical activity only or diet and
132 physical activity), intervention duration ((3-12 weeks or > 12 weeks) and length of follow up
133 (≤ 12 weeks, 13 weeks–6 months and > 6 months)). The threshold of 12 weeks was chosen
134 for intervention duration as this is the typical timespan used in lifestyle interventions. The
135 effect of lifestyle interventions in women with or without a history of gestational diabetes
136 mellitus (GDM) was also assessed.

137 A funnel plot was conducted to investigate the possibility of publication bias due to sample
138 size.

139 **Results**

140 The searches identified 1291 potentially eligible articles. After the removal of duplicates and
141 screening, nine systematic reviews of RCTs were eligible for inclusion in the systematic
142 review of reviews (see PRISMA flow diagram in Figure 1). Further details of the full papers
143 excluded and reasons for their exclusion are summarised in Table S1.

144 *Description of included systematic reviews*

145 The characteristics of the nine included systematic reviews are summarised in Table 2 and
146 described below. The reviews were published between 2008 and 2017 and included RCTs
147 with publication dates between 1994 and 2016. The majority of trials in the systematic
148 reviews were conducted in the USA, with the remaining trials conducted in Australia,
149 Canada, Greece, Iran, Japan, Malaysia, Sweden, Taiwan and Thailand (Table 2 and Table

150 S2). All of the included systematic reviews scored as either medium or high quality, except
151 for the review by Kuhlman et al. (31) which was also the oldest included systematic review
152 (details of the AMSTAR scoring for each included systematic review are listed in Table S3).

153 Seven of the nine systematic reviews had performed meta-analyses (32-38), while two
154 reported only a narrative synthesis (31, 39). No systematic review included exactly the same
155 RCTs. Each systematic review included between two and 33 RCTs, and there was overlap in
156 the RCTs included (see Table S2). Twenty-two RCTs were included in more than one
157 systematic review. Overall, there were 48 unique RCTs in the nine included systematic
158 reviews. The definition of the postnatal period also varied between systematic reviews. Three
159 defined this as up to 12 months after childbirth (32, 34, 38), one up to 18 months (36), one up
160 to 24 months (36). The remaining four systematic reviews stated that they included studies
161 with postnatal women, but did not define the postnatal period (31, 33, 37, 39).

162 Two of the systematic reviews placed no restrictions on the type of postnatal women they
163 included from studies (34, 35). However, three reviews included only women who either
164 have overweight and/ or have obesity (33, 36, 38), one systematic review only included
165 women with a history of gestational diabetes (39) and one included only healthy women (32).
166 Two did not report if they placed any restrictions on the type of postnatal women they would
167 include (31, 37).

168 The scope of the included systematic reviews varied. Five of the reviews included studies that
169 investigated the effectiveness of lifestyle interventions both during pregnancy and the
170 postnatal period (31-33, 37, 38). However, as the review authors performed analyses for these
171 populations separately, they were eligible for inclusion in this review of reviews. Two
172 reviews focused exclusively on e-health technology interventions (37, 38). One review
173 restricted its inclusion criteria to physical activity only interventions (32) while one focused
174 on postnatal lifestyle interventions to prevent type 2 diabetes (39). The remaining five

systematic reviews focused on different diet and physical activity modification interventions (31, 33-36) (see Table 2).

Mega meta-analysis of weight data

While there were 48 unique RCTs included in the systematic reviews, 13 did not report weight-related data, therefore only 35 of these were considered potentially eligible for inclusion in the mega meta-analysis. However, two were published in Chinese (40, 41) and therefore excluded. This meant 33 unique trials were eligible for inclusion in the meta-analysis. In addition to the above exclusion, a further 11 RCTs were excluded from the mega meta-analysis, mostly due to a lack of useable reported weight data (other reasons for exclusion are given in Table S4).

All the included RCTs reported that they objectively assessed weight, except for the RCT by Youngwanichsetha et al. (42), which did not clearly state that weight-related data were objectively collected. Therefore the mega meta-analysis included data from 22 unique RCTs and 1553 postnatal women and demonstrated that overall women randomised to a lifestyle intervention had significantly lower body weight at last follow up than comparators (mean difference of -1.7kg (95% CI -2.3, -1.1) (Figure 2).

Most RCTs included in the reviews did not report data by weight status and those that did reported it inconsistently or in a format that could not be used in the mega meta-analysis, therefore a sub-group analysis on the basis of weight status was not possible.

Subgroup analyses

Intervention type (Figure 2)

When analyses were restricted to combined physical activity and diet interventions trials the mean change in weight was -1.9kg (95% CI -2.9, -1.0, $P<0.01$, $I^2=62\%$, 16 comparisons) relative to comparators. Analysis of physical activity only interventions resulted in a weight

change of -1.6kg (95% CI -2.1, -1.2, P<0.01, 9 comparisons) relative to comparators and no heterogeneity (I^2=0%). There was only one study in the diet only subgroup analysis (43) and this showed that the dietary intervention significantly reduced postnatal weight (MD = -9.3kg (95% CI -16.5, -2.1, P=0.01) relative to comparators.

Intervention duration (Figure 3)

The mean weight change for participants who received interventions of between 3-12 weeks duration was -2.6kg lower than the comparator group (95% CI -3.6, -1.6, P<0.01, I^2=68%, 12 comparisons). In the analysis where only trials greater than 12 weeks duration were included, participants who received an intervention were 1.5kg lighter than comparators at follow up (95% CI -2.5, -0.6, P=0.002, I^2=24%, 12 comparisons).

History of GDM (Figure 4)

When analysis was restricted to trials that had included only women without a history of GDM the intervention group lost 1.8kg more than comparators at follow up (95% CI -2.5, -1.1, P<0.01 and I^2=54%, 21 comparisons). When the analyses were repeated for women with a history of GDM participants who received an intervention were 1.6kg lighter than comparators at follow up (95% CI -2.9, -0.2, P=0.02, I^2=17%, 5 comparisons).

Length of follow up (Figure 5)

The mean weight change for participants at follow up 12 weeks or less was -2.0kg lower than the comparator group (95% CI -2.8, -1.1, P<0.01, I^2=54%, 8 comparisons). At follow up between 13 weeks and six months, participants who received an intervention were 1.5kg lighter than comparators at follow up (95% CI -2.6, -0.4, P=0.006, I^2=24%, 10 comparisons), while at more than six months follow up, participants who received an intervention were 1.9kg lighter than comparators at follow up (95% CI -3.4, -0.5, P=0.01, I^2=56%, 8 comparisons).

223 The funnel plot (Figure S1) displayed some asymmetry, suggesting the possibility of some
224 bias, due to a lack of published studies with larger sample sizes.

225 **Discussion**

226 This systematic review of systematic reviews of RCTs has comprehensively and
227 systematically synthesised both descriptive and statistical evidence of the effects of lifestyle
228 interventions for postnatal weight management for the first time. Nine systematic reviews
229 that had included RCTs were eligible for inclusion in this review of reviews. Overall these
230 reviews concluded that lifestyle interventions were effective in reducing weight in postnatal
231 women. Based on the current available evidence, pooled results in our mega meta-analysis
232 also showed that lifestyle interventions significantly reduced weight in postnatal women by -
233 1.7kg (95% CI -2.3, -1.1) relative to comparators at follow up. Interventions that involved
234 both diet and physical activity interventions, physical activity alone and dietary interventions
235 alone were all effective, relative to comparators, although there was only one trial in the diet
236 only analysis. In women with a history of GDM postnatal weight was -1.6kg (95% CI -2.9, -
237 0.2) lower than comparators, and lifestyle interventions appeared as effective in women with
238 and without a history of GDM (1.6kg versus 1.8kg respectively). Interventions of shorter
239 duration (3-12 weeks) appeared to be more effective in reducing postnatal weight than longer
240 interventions, although this may be the result of recidivism where it becomes harder to lose
241 and maintain weight over time in longer interventions and which therefore have longer follow
242 up assessments. The AMSTAR scores for the systematic reviews increased in line with the
243 year of publication and coincided with the transition of QUORUM (44) to PRISMA (45) and
244 requirements from journals for better reporting of trials and systematic reviews (46).

245 *Comparison with the literature*

246 Despite some variation in the inclusion and exclusion criteria adopted by the nine included
247 systematic reviews, all reviews reported that lifestyle interventions reduced postnatal weight.

248 This is consistent with the findings of reviews involving other adult populations (47). The
249 mega meta-analysis showed that lifestyle interventions to date have been moderately
250 effective in helping women lose about 1.7kg of weight in the postnatal period, but weight loss
251 does not have be large to be important for health. This reduction in weight is similar to that
252 reported by several of the meta-analyses reported in the included systematic reviews,
253 demonstrating consistency of results (32, 33, 36). Clinical guidance from the National
254 Institute for Health and Care Excellence (NICE) in England suggests that weight loss of
255 approximately 2kg is clinically important for health (48) and can contribute towards an
256 effective reduction in the risk of cardiovascular disease and type II diabetes mellitus (49).
257 Modelling has also shown that even if a small amount of weight is lost, this weight loss
258 remains cost effective if the weight regained occurs on a lower weight trajectory (50).
259 Furthermore, as the relationship between obesity and mortality is linear even small amounts
260 of weight loss may be clinically important (49, 51, 52).

261 It is important to set the results of this study in context with other types of weight loss
262 interventions that postnatal women may choose to use. Evidence suggests that commercial
263 weight loss programmes are an effective intervention for weight loss and people attending
264 these types of programmes will lose on average about 5kg (24), which is substantially higher
265 than our pooled estimate here (-1.7kg).

266 Three trials in the mega meta-analysis reported weight loss (relative to comparators) of the
267 same magnitude or greater than reported for commercial weight loss programmes (43, 53,
268 54), but these trials all involved very intensive and expensive interventions that would be
269 difficult for health care services to fund for the large number of women who need to lose
270 weight after having a baby. The study by O'Toole et al. (53) involved an individually
271 structured diet and physical activity intervention developed by a dietician and a physiologist.
272 Participants were asked to record their daily food consumption in a food diary and attended

273 weekly group sessions for the first 12 weeks, then once every two weeks for two months and
274 then once a month until one year postnatal. The other two trials with weight loss greater than
275 4.5kg in the mega meta-analysis (43, 54) also involved intensive and/or lengthy interventions
276 involving behaviour modification counselling, motivational interviewing or specialised
277 dietetic support, none of which can be easily implemented at a population or community
278 health level. Additionally, all three of the trials reporting effects greater than 4.5kg
279 randomised very small numbers of participants (ranged from 23-57 participants) (43, 53, 54)
280 and their estimates may therefore be susceptible to bias.

281 Taken together this raises the question of whether it might be more useful to refer or
282 encourage postnatal women, who wish to lose weight, to a commercial weight loss
283 programme since this may be more effective and provision is already in place for women to
284 attend such programmes, both during and after pregnancy. Some even promote their
285 programme as being suitable for all, including pregnant and breastfeeding women (55) or
286 from six weeks after childbirth (56). Furthermore, a very recent trial in the UK (23) found
287 that referral of adult patients with obesity to commercial weight management programmes by
288 family doctors during routine consultations can be an effective weight loss intervention.
289 Nevertheless, postnatal women are a unique subgroup of the population with many
290 challenges and barriers that may impact their ability to consistently attend commercial weight
291 loss programmes, for example, availability of childcare, child feeding and sleeping patterns.
292 Future research should address this question.

293 Research evidence has been inconsistent on the preference of postnatal women for different
294 types of weight management interventions with some reporting that women prefer to attend
295 group-based sessions (57, 58), while others found that home-based interventions are preferred
296 due to issues such as time constraints, convenience and childcare requirements (59, 60). A
297 recent systematic review that compared self-help interventions (such as printed materials,

internet, mobile phone apps, etc.) with controls in general populations reported a significant effect favouring the interventions at six months follow up (-1.9kg (95% CI -2.9, -0.8)) (61). Self-help interventions are attractive because they are low cost, varied, flexible and can be tailored to the specific needs of the individual. Given many postnatal women might find it difficult to attend more formal weight loss programmes and some have expressed a preference for home-based programmes, self-help interventions for postnatal weight loss are worthy of consideration. Particularly as the effect estimate (-1.9kg (95% CI -2.9, -0.8)) in self-help interventions is similar to the result in our mega meta-analysis (-1.7kg (95% CI -2.3, -1.1), in which the interventions tested, typically, involved professional support and/or more resource intensive interventions than self-help interventions.

Physical activity and diet only interventions

Our findings showed that both physical activity and diet only interventions can be effective in reducing weight in postnatal women. Only one trial that recruited a small sample was eligible for inclusion in the diet only analysis highlighting the need for more studies on this question in this population of women. The recent scientific report and systematic review by the American Physical Activity Guidelines Committee concluded that there was insufficient evidence to determine whether physical activity is associated with weight loss during postnatal period. Our systematic review provides an up to date summary of the current evidence by concluding physical activity interventions can play a role in reducing weight after childbirth (-1.6 kg), relative to comparator groups (62).

Strengths and limitations

This review has a number of strengths and limitations that need to be considered when interpreting the findings. Our review focused only on systematic reviews that had included RCTs in order to summarise high quality evidence. Drawing together these findings in one place has generated a comprehensive evidence-based review of the effectiveness of lifestyle

interventions for postnatal women. Data from this systematic review of systematic reviews can be used to guide the development and design of future interventions in this population, as well as future health policy for postnatal women. By performing a mega meta-analysis of previous meta-analyses, we have provided a quantitative estimate of the amount of weight loss that can be obtained from behavioural lifestyle interventions for weight loss in this population of women.

A limitation of some of the trials included in the individual systematic reviews was the broad range in the number of months postnatal women could be to meet the systematic review inclusion criteria. It was therefore not possible to determine the effect of the intervention in relation to the time it was initiated during the postnatal period. We excluded unpublished systematic reviews and we did not search grey literature. We were unable to include one systematic review (63) due to a lack of clarity regarding the inclusion and exclusion criteria and the authors did not respond to our request for more information.

Most of the trials within the included systematic reviews were conducted in America and most participants were of white ethnicity, so the findings from the systematic reviews, and by implication our findings, may not be generalisable to other ethnic groups. We did not contact study authors of RCTs where there was unusable weight data because most were more than five years old. As expected there was some overlap of trials between the nine included systematic reviews. However, this is a particular advantage of performing a mega meta-analysis since each trial only contributes once to the overall pooled findings. In the overall pooled estimate there was a moderate level of heterogeneity which is likely to be the result of the variation in the types/content of interventions (64). This heterogeneity was only partially resolved by subgroup analyses.

There were limited data (one small trial) on diet only interventions and this remains an important avenue for future research. The most recent RCT included in any systematic review

348 was published in 2015, highlighting the need now for more trials to test the feasibility and
349 effectiveness of novel lifestyle interventions for weight loss in postnatal women. Bias was
350 considered with the aid of a funnel plot (Figure S1). The asymmetry of the funnel plot
351 suggests the possibility of some bias, due to a lack of published studies with larger sample
352 sizes.

353 Our review did not find any RCTs that have tested an intervention embedded within routine
354 health care appointments and this might be a pragmatic way to offer support to all postnatal
355 women who wish to lose weight after having a baby. Evaluation of these types of
356 interventions is an important direction for further research. The analysis involving women
357 with a history of GDM only included five small trials, therefore this result should be
358 interpreted as preliminary.

359 **Conclusion**

360 This systematic review of systematic reviews and mega meta-analysis of RCTs found that
361 lifestyle interventions are moderately effective in reducing weight after childbirth. Clinical
362 guidance for the care of postnatal women should be updated to reflect the findings of this
363 review and the accompanying mega meta-analysis.

364

365

366

367 **List of figures and tables**

375 **References**

376 1. Haffner SM. The metabolic syndrome: inflammation, diabetes mellitus, and
377 cardiovascular disease. Am J Cardiol. 2006; 97(2a):3a-11a.
378 2. Lu Y, Hajifathalian K, Ezzati M, Woodward M, Rimm EB, Danaei G. Metabolic
379 mediators of the effects of body-mass index, overweight, and obesity on coronary heart disease
380 and stroke: a pooled analysis of 97 prospective cohorts with 1.8 million participants. Lancet.
381 2014; 383(9921):970-983.
382 3. De Pergola G, Silvestris F. Obesity as a major risk factor for cancer. J Obes.
383 2013;2013:291546.
384 4. NHS Digital. National Statistics. Statistics on Obesity, Physical Activity and Diet,
385 England 2017; May 2017 [Available from:
386 https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/613532/obes-
387 phys-acti-diet-eng-2017-rep.pdf].
388 5. National Center for Health Statistics. Health, United States, 2016: with chartbook on
389 long-term trends in health. Hyattsville, MD, 2017.
390 6. Australian Institute of Health and Welfare 2016. Australia's health: 2016. Australia's
391 health series no.15. Cat. No. Aus 199. Canberra: AIHW. [Available from:
392 https://www.aihw.gov.au/getmedia/9844cefb-7745-4dd8-9ee2-f4d1c3d6a727/19787-
393 AH16.pdf.aspx].
394 7. Ohlin A, Rossner S. Maternal body weight development after pregnancy. Int J Obes.
395 1990; 14(2):159-173.
396 8. Walker L. Managing excessive weight gain during pregnancy and the postpartum
397 period. J Obstet Gynecol Neonatal Nurs. 2007; 36(5):490-500.
398 9. Walker L, Timmerman G, Sterling B, Kim M, Dickson P. Do low-income women attain
399 their pre-pregnant weight by the 6th week postpartum? Ethn Dis. 2004; 14:119-126.
400 10. McClure CK, Catov JM, Ness R, Bodnar LM. Associations between gestational weight
401 gain and BMI, abdominal adiposity, and traditional measures of cardiometabolic risk in
402 mothers 8 y postpartum. Am J Clin Nutr. 2013;98(5):1218-1225.
403 11. Althuizen E, van Poppel MN, de Vries JH, Seidell JC, van Mechelen W. Postpartum
404 behaviour as predictor of weight change from before pregnancy to one year postpartum. BMC
405 Public Health. 2011; 11(1):165.
406 12. Linné Y, Barkeling B, Rossner S. Long-term weight development after pregnancy.
407 Obes Rev 2002; 3(2):75-83.

408 13. Linné Y, Dye L, Barkeling B and Rossner S. Long-term weight development in women:
409 a 15-year follow-up of the effects of pregnancy. Obes Res. 2004; 12(7):1166-78.
410 14. Walker L. Predictors of weight gain at 6 and 18 months after childbirth: a pilot study. J
411 Obstet Gynecol Neonatal Nurs. 1996; 25(1):39-48.
412 15. Rooney BL, Schauberger CW. Excess pregnancy weight gain and long-term obesity:
413 one decade later. Obstet and Gynecol. 2002;100(2):245-252.
414 16. Gunderson EP, Murtaugh MA, Lewis CE, Quesenberry CP, West DS and Sidney S.
415 Excess gains in weight and waist circumference associated with childbearing: The Coronary
416 Artery Risk Development in Young Adults Study (CARDIA). Int J Obes Relat Metab Disord.
417 2004; 28(4):525-535.
418 17. Klein S, Allison DB, Heymsfield SB, et al. Waist circumference and cardiometabolic
419 risk: a consensus statement from Shaping America's Health: Association for Weight
420 Management and Obesity Prevention; NAASO, The Obesity Society; the American Society for
421 Nutrition; and the American Diabetes Association. Am J Clin Nutr. 2007; 85(5):1197-1202.
422 18. Kulie T, Slattengren A, Redmer J, Counts H, Eglash A and Schrager S. Obesity and
423 women's health: an evidence-based review. J Am Board of Fam Med. 2011; 24(1):75-85.
424 19. Chu SY, Callaghan WM, Bish CL and D'Angelo D. Gestational weight gain by body
425 mass index among US women delivering live births, 2004-2005: fueling future obesity. Am J
426 Obstet Gynecol. 2009; 200(3):271.e1-7.
427 20. Murray L. The impact of postnatal depression on infant development. J Child Psychol
428 Psychiatry. 1992; 33(3):543-561.
429 21. Cooper PJ, Murray L. Course and recurrence of postnatal depression. Evidence for the
430 specificity of the diagnostic concept. Br J Psychiatry. 1995; 166(2):191-195.
431 22. Herring SJ, Rich-Edwards JW, Oken E, Rifas-Shiman SL, Kleinman KP, Gillman MW.
432 Association of postpartum depression with weight retention 1 year after childbirth. Obesity
433 2008; 16(6):1296-1301.
434 23. Aveyard P, Lewis A, Tearne S, et al. Screening and brief intervention for obesity in
435 primary care: a parallel, two-arm, randomised trial. Lancet. 2016; 388(10059):2492-2 500.
436 24. Jolly K, Lewis A, Beach J, Denley J, Adab P, Deeks JJ. Comparison of range of
437 commercial or primary care led weight reduction programmes with minimal intervention
438 control for weight loss in obesity: Lighten Up randomised controlled trial. BMJ.
439 2011;343:d6500.
440 25. Østbye T, Krause K, Lovelady C, et al. Active mothers postpartum: a randomized
441 controlled weight-loss intervention trial. Am J Prev Med. 2009; 37(3):173-180.

442 26. Shea BJ, Grimshaw JM, Wells GA, et al. Development of AMSTAR: a measurement
443 tool to assess the methodological quality of systematic reviews. BMC Med Res Methodol.
444 2007; 7(1):10.
445 27. The Cochrane Collaboration. Review Manager (RevMan) Version 5.3 ed. Copenhagen:
446 The Nordic Cochrane Centre, 2014.
447 28. Kaiser KA, Affuso O, Beasley TM and Allison DB. Getting carried away: a note
448 showing baseline observation carried forward (BOCF) results can be calculated from published
449 complete-cases results. Int J Obes. 2012; 36(6):886-889.
450 29. Higgins JP, Thompson SG. Quantifying heterogeneity in a meta-analysis. Stat Med.
451 2002; 21(11):1539-58.
452 30. Higgins JP, Thompson SG, Deeks JJ and Altman DG. Measuring inconsistency in meta-
453 analyses. BMJ. 2003; 327(7414):557-560.
454 31. Kuhlmann AK, Dietz PM, Galavotti C, England LJ. Weight-management interventions
455 for pregnant or postpartum women. Am J Prev Med. 2008; 34(6):523-528.
456 32. Elliott-Sale KJ, Barnett CT, Sale C. Exercise interventions for weight management
457 during pregnancy and up to 1 year postpartum among normal weight, overweight and obese
458 women: a systematic review and meta-analysis. Br J Sports Med 2015;49(20):1336-1342.
459 33. Choi J, Fukuoka Y, Lee JH. The effects of physical activity and physical activity plus
460 diet interventions on body weight in overweight or obese women who are pregnant or in
461 postpartum: a systematic review and meta-analysis of randomized controlled trials. Prev Med.
462 2013; 56(6):351-364.
463 34. Lim S, O'Reilly S, Behrens H, Skinner T, Ellis I and Dunbar JA. Effective strategies for
464 weight loss in post-partum women: a systematic review and meta-analysis. Obes Rev. 2015;
465 16(11):972-987.
466 35. Nascimento SL, Pudwell J, Surita FG, Adamo KB and Smith GN. The effect of physical
467 exercise strategies on weight loss in postpartum women: a systematic review and meta-
468 analysis. Int J Obes 2014; 38(5):626-635.
469 36. Amorim Adegboye AR, Linne YM. Diet or exercise, or both, for weight reduction in
470 women after childbirth. Cochrane Database Syst Rev. 2013 (7):CD005627.
471 37. Sherifali D, Nerenberg KA, Wilson S, et al. The effectiveness of eHealth technologies
472 on weight management in pregnant and postpartum women: systematic review and meta-
473 analysis. J Med Internet Res. 2017; 19(10):e337.

474 38. Lau Y, Klainin-Yobas P, Htun TP, et al. Electronic-based lifestyle interventions in
475 overweight or obese perinatal women: a systematic review and meta-analysis. Obes Rev. 2017;
476 18(9):1071-1087.
477 39. Guo J, Chen JL, Whittemore R and Whitaker E. Postpartum lifestyle interventions to
478 prevent type 2 diabetes among women with history of gestational diabetes: a systematic review
479 of randomized clinical trials. J Womens Health. 2002. 2016;25(1):38-49.
480 40. Ji W. Effects of a lifestyle intervention on glycometabolism in women having
481 gestational diabetes mellitus and impaired glucose tolerance after delivery (in Chinese). In:
482 Beijing: School of Nursing PUMC, editor. 2011. p. 35-53.
483 41. Yu X.Y., Wu X.M., Zhang Y., Mao Y.S. The effects of lifestyle intervention on insulin
484 resistance and islet β cell function in gestational diabetes patients with postpartum impaired
485 glucose regulation (in Chinese). Chin J Prev Contr Chron Dis. 2012 (20):560-562.
486 42. Youngwanichsetha S, Phumdoung S, Ingkathawornwong T. The effects of tai chi
487 qigong exercise on plasma glucose levels and health status of postpartum Thai women with
488 type 2 diabetes. Focus Altern Complementary Ther. 2013; 18(4):182-187.
489 43. Bertz F, Brekke HK, Ellegard L, Rasmussen KM, Wennergren M, Winkvist A. Diet and
490 exercise weight-loss trial in lactating overweight and obese women. Am J Clin Nutr. 2012;
491 96(4):698-705.
492 44. Moher D, Cook DJ, Eastwood S, Olkin I, Rennie D, Stroup DF. Improving the quality
493 of reports of meta-analyses of randomised controlled trials: the QUOROM statement. Lancet.
494 1999;354(9193):1896-1900.
495 45. Tao K-m, Li X-q, Zhou Q-h, Moher D, Ling C-q, Yu W-f. From QUOROM to
496 PRISMA: a survey of high-impact medical journals' instructions to authors and a review of
497 systematic reviews in anesthesia literature. PLoS One. 2011; 6(11):e27611.
498 46. Panic N, Leoncini E, de Belvis G, Ricciardi W, Boccia S. Evaluation of the
499 endorsement of the preferred reporting items for systematic reviews and meta-analysis
500 (PRISMA) statement on the quality of published systematic review and meta-analyses. PLoS
501 One. 2013; 8(12):e83138.
502 47. Johns DJ, Hartmann-Boyce J, Jebb SA, Aveyard P. Diet or exercise interventions vs
503 combined behavioral weight management programs: a systematic review and meta-analysis of
504 direct comparisons. J Acad Nutr Diet. 2014; 114(10):1557-1568.

505 48. National Institute for Health and Care Excellence (NICE). Putting NICE guidance into
506 practice. Costing Report: Obesity. Implementing the NICE guideline on obesity (CG189). 2014
507 [Available from: https://www.nice.org.uk/guidance/cg189/resources/costing-report-pdf-
508 193304845.]
509 49. Wing RR, Lang W, Wadden TA, et al. Benefits of modest weight loss in improving
510 cardiovascular risk factors in overweight and obese individuals with type 2 diabetes. Diabetes
511 Care. 2011; 34(7):1481-1486.
512 50. National Institute for Health and Care Excellence (NICE). Costing Report: Managing
513 overweight and obesity in adults: lifestyle weight management services. 2014 [Available from:
514 https://www.nice.org.uk/guidance/ph53/resources/costing-report-pdf-69241357.]
515 51. Magkos F, Fraterrigo G, Yoshino J, et al. Effects of moderate and subsequent
516 progressive weight loss on metabolic function and adipose tissue biology in humans with
517 obesity. Cell Metab. 2016; 23(4):591-601.
518 52. Ma C, Avenell A, Bolland M, et al. Effects of weight loss interventions for adults who
519 are obese on mortality, cardiovascular disease, and cancer: systematic review and meta-
520 analysis. BMJ. 2017;359: j4849.
521 53. O'Toole ML, Sawicki MA, Artal R. Structured diet and physical activity prevent
522 postpartum weight retention. J Womens Health. 2003;12(10):991-998.
523 54. Reinhardt JA, van der Ploeg HP, Grzegrzulka R, Timperley JG. lmplementing lifestyle
524 change through phone-based motivational interviewing in rural-based women with previous
525 gestational diabetes mellitus. Health Promot J Austr. 2012; 23(1):5-9.
526 55. Slimming World. Suitable for all 2018 [Available from:
527 https://www.slimmingworld.co.uk/health/how-sw-works/suitable-for-all.aspx.]
528 56. Weight Watchers International Inc. Health and Safety 2018 [Available from:
529 https://www.weightwatchers.com/uk/health-and-safety-weight-watchers-uk.]
530 57. Setse R, Grogan R, Cooper LA, Strobino D, Powe NR, Nicholson W. Weight loss
531 programs for urban-based, postpartum African-American women: perceived barriers and
532 preferred components. Matern Child Health J. 2008; 12(1):119-127.
533 58. Phelan S. Pregnancy: a "teachable moment" for weight control and obesity prevention.
534 Am J Obstet Gynecol. 2010; 202(2):135.e1-8.
535 59. Craigie AM, Macleod M, Barton KL, Treweek S, Anderson AS. Supporting postpartum
536 weight loss in women living in deprived communities: design implications for a randomised
537 control trial. Eur J Clin Nutr. 2011; 65(8):952-958.

538 60. Atkinson L, Olander EK, French DP. Why don't many obese pregnant and post-natal
539 women engage with a weight management service? J Reprod Infant Psychol. 2013; 31(3):245-
540 256.
541 61. Hartmann-Boyce J, Jebb SA, Fletcher BR, Aveyard P. Self-help for weight loss in
542 overweight and obese adults: systematic review and meta-analysis. Am J Public Health. 2015;
543 105(3):e43-57.
544 62. 2018 Physical Activity Guidelines Advisory Committee. 2018 Physical Activity
545 Guidelines Advisory Committee Scientific Report. Washington, DC: U.S. Department of
546 Health and Human Services; 2018.
547 63. Berger AA, Peragallo-Urrutia R, Nicholson WK. Systematic review of the effect of
548 individual and combined nutrition and exercise interventions on weight, adiposity and
549 metabolic outcomes after delivery: evidence for developing behavioral guidelines for post-
550 partum weight control. BMC Pregnancy Childbirth. 2014; 14:319.
551 64. Higgins JPT, Green S (editors). *Cochrane Handbook for Systematic Reviews of*
552 *Interventions* Version 5.1.0 [updated March 2011]. The Cochrane Collaboration, 2011.
553 Available from www.handbook.cochrane.org.
554 65. Wiltheiss GA, Lovelady CA, West DG, Brouwer RJ, Krause KM, Ostbye T. Diet
555 quality and weight change among overweight and obese postpartum women enrolled in a
556 behavioral intervention program. J Acad Nutr Diet. 2013; 113(1):54-62.

557