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Diet or exercise, or both, for preventing excessive weight gain in pregnancy (Review)

Muktabhant B, Lawrie TA, Lumbiganon P, Laopaiboon M

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[Intervention Review]

Diet or exercise, or both, for preventing excessive weight gain in pregnancy

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ABSTRACT

Background

This is an update of a Cochrane review first published in 2012, Issue 4. Excessive weight gain during pregnancy is associated with poor maternal and neonatal outcomes including gestational diabetes, hypertension, caesarean section, macrosomia, and stillbirth. Diet or exercise interventions, or both, may reduce excessive gestational weight gain (GWG) and associated poor outcomes; however, evidence from the original review was inconclusive.

Objectives

To evaluate the effectiveness of diet or exercise, or both, interventions for preventing excessive weight gain during pregnancy and associated pregnancy complications.

Search methods

We searched the Cochrane Pregnancy and Childbirth Group's Trials Register (5 November 2014), contacted investigators of the previously identified ongoing studies and scanned reference lists of retrieved studies.

Selection criteria

Randomised controlled trials (RCTs) of diet or exercise, or both, interventions for preventing excessive weight gain in pregnancy.

Data collection and analysis

Two review authors independently assessed trials for inclusion and risk of bias, extracted data and checked them for accuracy. We organised RCTs according to the type of interventions and pooled data using the random-effects model in the Review Manager software. We also performed subgroup analyses according to the initial risk of adverse effects related to poor weight control. We performed sensitivity analysis to assess the robustness of the findings.

Main results

We included 65 RCTs, out of which 49 RCTs involving 11,444 women contributed data to quantitative meta-analysis. Twenty studies were at moderate-to-high risk of bias. Study interventions involved mainly diet only, exercise only, and combined diet and exercise interventions, usually compared with standard care. Study methods varied widely; therefore, we estimated the average effect across studies and performed sensitivity analysis, where appropriate, by excluding outliers and studies at high risk of bias.

Diet or exercise, or both, for preventing excessive weight gain in pregnancy (Review)

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Diet or exercise, or both, interventions reduced the risk of excessive GWG on average by 20% overall (average risk ratio (RR) 0.80, 95% confidence interval (CI) 0.73 to 0.87; participants = 7096; studies = 24; $I^2 = 52\%$). This estimate was robust to sensitivity analysis, which reduced heterogeneity, therefore we graded this evidence as high-quality. Interventions involving low glycaemic load diets, supervised or unsupervised exercise only, or diet and exercise combined all led to similar reductions in the number of women gaining excessive weight in pregnancy.

Women receiving diet or exercise, or both interventions were more likely to experience low GWG than those in control groups (average RR 1.14, 95% CI 1.02 to 1.27; participants = 4422; studies = 11; $I^2 = 3\%$; *moderate-quality evidence*). We found no difference between intervention and control groups with regard to pre-eclampsia (RR 0.95, 95% CI 0.77 to 1.16; participants = 5330; studies = 15; $I^2 = 0\%$; *high-quality evidence*); however, maternal hypertension (not a pre-specified outcome) was reduced in the intervention group compared with the control group overall (average RR 0.70, 95% CI 0.51 to 0.96; participants = 5162; studies = 11; $I^2 = 43\%$; *low-quality evidence*).

There was no clear difference between groups with regard to caesarean delivery overall (RR 0.95, 95% CI 0.88 to 1.03; participants = 7534; studies = 28; $I^2 = 9\%$; *high-quality evidence*); although the effect estimate suggested a small difference (5%) in favour of the interventions. In addition, for combined diet and exercise counselling interventions there was a 13% (-1% to 25%) reduction in this outcome (borderline statistical significance).

We found no difference between groups with regard to preterm birth overall (average RR 0.91, 95% CI 0.68 to 1.22; participants = 5923; studies = 16; $I^2 = 16\%$; *moderate-quality evidence*); however limited evidence suggested that these effect estimates may differ according to the types of interventions, with a trend towards an increased risk for exercise-only interventions.

We found no clear difference between intervention and control groups with regard to infant macrosomia (average RR 0.93, 95% CI 0.86 to 1.02; participants = 8598; studies = 27; $I^2 = 0\%$; *high-quality evidence*), although the effect estimate suggested a small difference (7% reduction) in favour of the intervention group. The largest effect size occurred in the supervised exercise-only intervention group (RR 0.81, 95% CI 0.64 to 1.02; participants = 2445; studies = 7; $I^2 = 0\%$), which approached statistical significance ($P = 0.07$). Furthermore, in subgroup analysis by risk, high-risk women (overweight or obese women, or women with or at risk of gestational diabetes) receiving combined diet and exercise counselling interventions experienced a 15% reduced risk of infant macrosomia (average RR 0.85, 95% CI 0.73 to 1.00; participants = 3252; studies = nine; $I^2 = 0$; $P = 0.05$; *moderate-quality evidence*).

There were no differences in the risk of poor neonatal outcomes including shoulder dystocia, neonatal hypoglycaemia, hyperbilirubinaemia, or birth trauma (all *moderate-quality evidence*) between intervention and control groups; however, infants of high-risk women had a reduced risk of respiratory distress syndrome if their mothers were in the intervention group (RR 0.47, 95% CI 0.26 to 0.85; participants = 2256; studies = two; $I^2 = 0\%$; *moderate-quality evidence*).

Authors' conclusions

High-quality evidence indicates that diet or exercise, or both, during pregnancy can reduce the risk of excessive GWG. Other benefits may include a lower risk of caesarean delivery, macrosomia, and neonatal respiratory morbidity, particularly for high-risk women receiving combined diet and exercise interventions. Maternal hypertension may also be reduced. Exercise appears to be an important part of controlling weight gain in pregnancy and more research is needed to establish safe guidelines. Most included studies were carried out in developed countries and it is not clear whether these results are widely applicable to lower income settings.

PLAIN LANGUAGE SUMMARY

Diet and exercise interventions for preventing excessive weight gain during pregnancy

The issue

A large proportion of women gain more weight than is recommended during pregnancy. Excessive weight gain in pregnancy is associated with complications such as diabetes, high blood pressure, caesarean section, and large babies. This review aimed to determine whether diet or exercise measures, or both, could prevent excessive gestational weight gain (GWG), and if they were safe.

How we conducted the review

This is an update of a review first published in 2012 and is current to November 2014 and included randomised controlled trials (RCTs) only in the updated review. We grouped studies according to the types of interventions, and according to the types of participants, i.e. normal weight women (the low-risk group), all pregnant women (the mixed-risk group), and overweight or obese women, or women with or at risk of gestational diabetes (the high-risk group).

Findings

We included 65 randomised controlled trials, of which 49 trials involving 11,444 women contributed data. Twenty studies were at a moderate-to high-risk of bias. The diets tested were low sugar (low glycaemic load), diabetic, low-calorie or low-fat diets, with or without food diaries and regular weighing. The exercise interventions were most often of moderate intensity and involving regular walking, dance or aerobic classes. The comparison or control group generally received standard care. Overall, weight management interventions led to

a reduction in the number of women gaining excess weight by a fifth (20%; range 13% to 27%) over the pregnancy. We considered this evidence to be high-quality.

Overall, we found no clear benefits of all diet or exercise interventions, or both, on other outcomes including pre-eclampsia, caesarean section, preterm birth, and having a baby weighing more than 4 kg (macrosomia), although we could not rule out a small effect on caesarean section (5% reduction) and macrosomia (7% reduction), particularly for women receiving combined diet and exercise counselling interventions. There was a tendency for supervised exercise-only interventions to reduce macrosomia too. Maternal hypertension (high blood pressure) was also reduced with the interventions. We found no clear differences between study groups with regard to most infant complications, except that for high-risk women the babies born to the women in the intervention group were less likely to experience breathing difficulties (respiratory distress syndrome) than babies in the control group. This evidence was mostly of a moderate quality.

The studies had differences in the types of interventions, types of participants (for example in terms of body mass index (BMI), number of previous pregnancies and age), delivery of the intervention (whether the intervention was incorporated into antenatal visits or delivered separately by a dietician), timing of the measurements, timing of commencement of the intervention (first, second or third trimester), the intensity of the intervention, and how it was monitored or supervised. Most included studies were carried out in developed countries and it is not clear whether these results are widely applicable to lower income settings.

Conclusions

We found high-quality evidence that diet or exercise interventions, or both, help to reduce excessive weight gain in pregnancy. They may also reduce caesarean deliveries, especially with combined diet and exercise interventions, and maternal hypertension. In addition, the chances of having a baby over 4 kg and the chances of the newborn having breathing difficulties after birth may be reduced, especially in overweight and obese women. Moderate-intensity exercise appears to be an important part of weight-control strategies in pregnancy; however, more research is needed on side-effects to inform safe guidelines.

SUMMARY OF FINDINGS

Summary of findings for the main comparison. All diet and/or exercise interventions compared to standard/other care for preventing excessive weight gain in pregnancy

All diet and/or exercise interventions compared to standard/other care for preventing excessive weight gain in pregnancy

Patient or population: pregnant women

Settings: antenatal care settings

Intervention: all diet and/or exercise interventions

Comparison: routine care or minimal interventions (e.g. brochures)

Outcomes	Illustrative comparative risks* (95% CI)		Relative effect (95% CI)	No of Participants (studies)	Quality of the evidence (GRADE)	Comments
	Assumed risk	Corresponding risk				
	Standard/other care	All diet and/or exercise interventions				
Excessive weight gain	Study population		RR 0.80 (0.73 to 0.87)	7096 (24 RCTs)	⊕⊕⊕⊕ HIGH ¹	
	453 per 1000	362 per 1000 (330 to 394)				
Mean GWG (kg)			Mean difference not estimated			Due to substantial heterogeneity among studies, we did not consider the pooled estimate to be meaningful. Limited subgroup analyses suggested that effect estimates might differ according to risk group.
Low weight gain	Study population		RR 1.14 (1.02 to 1.27)	4422 (11 RCTs)	⊕⊕⊕⊖ MODERATE ²	
	227 per 1000	259 per 1000 (232 to 288)				
Preterm birth	Study population		RR 0.91 (0.68 to 1.22)	5923 (16 RCTs)	⊕⊕⊕⊖ MODERATE ³	
	57 per 1000	52 per 1000 (39 to 70)				

Pre-eclampsia	Study population	RR 0.95 (0.77 to 1.16)	5330 (15 RCTs)	⊕⊕⊕⊕ HIGH
	66 per 1000 62 per 1000 (50 to 76)			
Caesarean delivery	Study population	RR 0.95 (0.88 to 1.03)	7534 (28 RCTs)	⊕⊕⊕⊕ HIGH
	288 per 1000 274 per 1000 (254 to 297)			
Macrosomia Infant birth-weight > 4000 g	Study population	RR 0.93 (0.86 to 1.02)	8598 (27 RCTs)	⊕⊕⊕⊕ HIGH
	178 per 1000 166 per 1000 (153 to 182)			

*The basis for the **assumed risk** was the median control group risk across studies. The **corresponding risk** (and its 95% confidence interval) is based on the assumed risk in the comparison group and the **relative effect** of the intervention (and its 95% CI).

CI: Confidence interval.

GRADE Working Group grades of evidence

High quality: Further research is very unlikely to change our confidence in the estimate of effect.

Moderate quality: Further research is likely to have an important impact on our confidence in the estimate of effect and may change the estimate.

Low quality: Further research is very likely to have an important impact on our confidence in the estimate of effect and is likely to change the estimate.

Very low quality: We are very uncertain about the estimate.

¹Although heterogeneity was moderate-to-high ($I^2 = 52\%$), the RR was robust to sensitivity analysis, which was associated with less heterogeneity ($I^2 = 40\%$), therefore we did not downgrade this evidence

²Downgraded due to imprecision of results according to types of intervention (-1)

³Downgraded due to risk of bias concerns and concerns that data could not be included in the analysis due to studies excluding women with or at risk of preterm birth post-randomisation from analysis (Cordero 2014; Di Carlo 2014; Murtezani 2014; Rauh 2013). This omission might have led to publication bias in the review's 'preterm birth' outcome (-1)

Summary of findings 2. Comparative table of findings by intervention type

Intervention type	Risk group	EGWG	Mean GWG	Low GWG	Preterm birth	Caesarean	Pre-eclampsia	Macroso-mia
All interventions (max 36 studies)	Overall	20% reduction (13 to 27%)	Not estimated	14% in-crease (2% to 27%)	NS	NS	NS	BS (7% re-duction, -2% to 14%)

Low GL diet (max 5 studies)	Overall	23% reduction (9% to 33%)	Not estimated	NS	BS in favour of the intervention	NS	NA	NS
	Low	40% reduction (6% to 52%)	NS	NS	NS	NS	NA	NA
	Mixed	21% reduction (1 study)	NS	NA	NS	NS	NA	NS
	High	NS	NS	NS	NS	NS	NA	NS
Diet and exercise counselling (max 13 studies)	Overall	14% reduction (2% to 25%)	Not estimated	NS	NS	BS (13% reduction; -1% to 25%)	NS	NS
	Low	28% reduction (5% to 45%)	NS	NS	NS	NS	NS	NS
	Mixed	NS	1.80 kg reduction (0.24 to 3.36 kg)	NA	NS	BS (34% reduction; -5% to 59%)	NA	NS
	High	NS	0.71 kg reduction (0.08 to 1.34)	NS	NS	BS (11% reduction; -4 to 24%)	NS	15% reduction (0% to 27%)
Exercise (supervised or unsupervised) only (max 10 studies)	Overall	21% reduction (11% to 30%)	Not estimated	BS (19% increase; 0% to 41%)	NS	NS	NS	NS
	Low	BS (31%; -2 to 53%)	1.50 kg reduction (0.92 to 2.08 kg; one study only)	29% increase; 6% to 42%)	BS (one study)	NS	NA	
	Mixed	23% reduction (12% to 34%)	1.35 kg reduction (0.89 to 1.80)	NS	NS	NS	NS	BS* (19% reduction; -2% to 36%)
	High	16% reduction (5% to 27%)	NS	NS	NS	NS	NS	NS
Unsupervised exercise only	Overall	17% reduction (3% to 29%)	Not estimated	NS	NS	NS	NS	NS

(max 3 studies)								
Supervised exercise only (max 7 studies)	Overall	25% reduction (11% to 37%)	Not estimated	BS (21% increase; -1% to 52%)	NS (trend in favour of control)	NS	NS	BS (19% reduction; -2% to 36%)
Diet and supervised exercise (max 5 studies)	Overall	29% reduction (15% to 41%)	NS	NS	NA	NS	NS	NS
	Low	NS	3.33 kg reduction (1,21 to 5.45; one study only)	NA	NA	Not estimable	NA	NA
	Mixed	36% reduction (16% to 52%)	1.69 kg reduction (0.11 to 3.48)	NS	NA	NS	NA	NS
	High	NS	NS	NA	NA	NS	NA	NS
Diet counselling/other (max 7 studies)	Overall	NS	Not estimated	NS	NS	NS	NS	NS
	Mixed	NS	NA	NA	NS	NS	NS	NA
	High	NS	NA	NA	NS	NS	NS	NS

Finding are presented with reference to the intervention group

* Sensitivity analysis suggested that there may be a statistically significant difference in favour of the intervention for the mixed-risk subgroup.

Abbreviations: NA = not available; NS = not statistically significant ($P \geq 0.05$); BS = borderline significance

BACKGROUND

Description of the condition

Pregnancy weight gain guidelines

In 2009, the Institute of Medicines (IOM) in the United States updated earlier guidelines on weight gain during pregnancy (Medicine 1990; Medicine 2009). The report set out specific ranges of weight gain for women with different prepregnancy weights: suggesting that underweight women (body mass index (BMI) less than 18.5 kg/m²) gain 28 lbs to 40 lbs (12.5 kg to 18 kg); normal weight women (BMI 18.5 kg/m² to 24.9 kg/m²) gain 25 lbs to 35 lbs (11.5 kg to 16 kg); whereas overweight women (BMI 25 kg/m² to 29.9 kg/m²) were advised to gain between 15 lbs and 25 lbs (7 kg to 11.5 kg) and obese women (BMI at least 30 kg/m²) to gain between 11 lbs and 20 lbs (5 kg to 9 kg) (Medicine 2009).

Previous guidelines from the IOM (Medicine 1990) had been widely adopted but not universally accepted. However, a review of relevant information confirmed that pregnancy weight gain within the IOM's recommended ranges was associated with the best outcomes for both mothers and infants, and that weight gain within the IOM's recommended ranges is not harmful for the mothers or for their infants (Abrams 2000).

No official recommendations or clinical guidelines for weight gain during pregnancy exist in the United Kingdom (UK) (Ford 2001). However, a report from the UK Centre for Maternal and Child Enquiries (CMACE 2010) suggested a more comprehensive guidance for the care of overweight and obese women, and recommended weighing women in the third trimester and again when women are admitted in labour. Guidelines in other countries have also recommended monitoring weight gain in pregnancy. In Sweden, it has been recommended that the optimal gestational weight gain for Swedish women is 4 kg to 10 kg for BMI less than 20, 2 kg to 10 kg for BMI 20 to 24.9; less than 9 kg for women with a BMI of 25 to 29.9, and less than 6 kg for women with a BMI of 30 or more (Cedergren 2007). Maternal weight gain recommendations based on data from high-income countries may not be applicable to Asian women, who appear to have lower weight gains compared with women in Europe and North America (Abrams 1995; Siega-Riz 1993). Weight gain limits for Chinese women, taking ethnic-specific differences into account, have been recommended as 13 kg to 16.7 kg, 11 kg to 16.4 kg, and 7.1 kg to 14.4 kg respectively for women of low (BMI less than 19), moderate (BMI 19 to 23.5), and high (BMI greater than 23.5) BMI (Wong 2000).

Trends in pregnancy weight gain

Although the 1990 IOM guidelines have now been promoted for two decades it has been estimated that over this time only 30% to 40% of pregnant women in the United States gain gestational weight within the IOM recommended ranges (Abrams 2000; Cogswell 1999; Medicine 1990; Olson 2003). Furthermore, gestational weight gain above the guidelines is more common than gestational weight gain below (Stotland 2006). Several studies on gestational weight gain in the USA and Europe indicate that about 20% to 40% of women are gaining weight above the recommendations (Cedergren 2006; Medicine 2009; Olson 2003) and the prevalence of excessive gestational weight gain is increasing (Abrams 2000; Rhodes 2003; Schieve 1998). A retrospective cohort study undertaken to examine the trend in weight gain during pregnancy of 1,463,936 women over 16 years in North Carolina found that the proportion of

women gaining excessive gestational weight (more than 18 kg) increased from 15.5% in 1988 to 19.5% in 2003; an additional 40 women per 1000 gained excessive weight by 2003 (Helms 2006). The recent IOM report summarised the situation in a number of countries; compared with two decades earlier "Women today are also heavier; a greater percentage of them are entering pregnancy overweight or obese, and many are gaining too much weight during pregnancy" (Medicine 2009).

Weight gain during pregnancy is generally inversely proportional to prepregnancy weight category. Although underweight women are least likely to exceed weight gain recommendations, obese women tend to gain less weight than normal and overweight women (Abrams 1989; Bianco 1998; Edwards 1996; Walling 2006). Two large population-based studies, in Sweden and the United States, found that approximately 30% of average and overweight women had high-gestational weight gain, compared with 20% of obese women (Cedergren 2006; Cogswell 1995).

Pregnancy weight gain and outcomes for mothers and infants

It is well known from large studies in a number of countries that excessive weight gain during pregnancy is associated with multiple maternal and neonatal complications. Retrospective cohort studies have examined the relationship between gestational weight gain and adverse neonatal outcomes among infants born at term. Gestational weight gain above the upper limit of the IOM guideline has been associated with a low five-minute Apgar score, seizure, hypoglycaemia, polycythaemia, meconium aspiration syndrome and large-for-gestational age compared with women within weight gain guidelines (Hedderson 2006; Stotland 2006). For obese women, low-gestational weight gain has been shown to decrease the risk of several undesirable outcomes including pre-eclampsia, caesarean section, instrumental delivery, and large-for-gestational-age births; whereas, excessive weight gain increased the risk for caesarean delivery in all maternal BMI classes (Cedergren 2006).

Findings from a national study in the UK revealed that compared with pregnant women in general, obese pregnant women were at increased risk of having a co-morbidity diagnosed before or during pregnancy (in particular pregnancy-induced hypertension and gestational diabetes), were at increased risk of having induction of labour and a caesarean birth, were more likely to have postpartum haemorrhage, and their babies were at increased risk of stillbirth, neonatal death, of being large-for-gestational age and more likely to be admitted for special care (CMACE 2010).

A number of studies have concluded that excessive gestational weight gain increases postpartum weight retention (Gunderson 2000; Keppel 1993; Polley 2002; Rooney 2002; Rossner 1997; Scholl 1995) and is related to a two- to three-fold increase in the risk of becoming overweight after delivery (Gunderson 2000). Moreover, mothers who gained more weight during pregnancy have been shown to have children at higher risk of being overweight in early childhood (Oken 2007).

Description of the intervention

Pregnancy may be an optimal time to inform and challenge women to change their eating habits and physical activities, and thereby prevent excessive weight gain. Dietary control, exercise and eating behaviour modification are the main elements for controlling weight. Dietary interventions include low glycaemic, energy-restricted, diabetic, healthy eating, low carbohydrate and

other diets. Regular exercise is an important part of a healthy lifestyle and most guidelines support moderate-intensity physical activity during pregnancy (Evenson 2014).

How the intervention might work

Diet and exercise interventions are recommended components of weight control programs in the general population. Diet interventions work mainly by limiting energy intake, whereas exercise interventions work by using energy. If one utilises more energy than one takes in, one creates an energy deficit, which facilitates the use of stored energy.

Why it is important to do this review

Pregnancy results in dramatic physiological changes, with weight gain occurring as part of the normal pregnancy process. This normal occurrence and expectation of weight gain in pregnancy can make it difficult for a woman of any prepregnancy weight to maintain her weight within recommended limits. Thus, pregnancy is a time when women especially need clear guidance on how best to maintain a healthy weight, in a way that will be safe for both mother and baby. Given the increasing prevalence and negative consequences of excessive gestational weight gain, preventing excessive weight gain during pregnancy is becoming increasingly important. The previous version of this review found weak evidence to support diet and exercise interventions to reduce gestational weight gain; however, findings were inconsistent and interventions heterogeneous. Despite this and another systematic review that included randomised and non-randomised studies (Thangaratinam 2012), it remains unclear which types of interventions will yield the best outcomes for mothers and their infants, and whether interventions work equally for all risk groups. Pregnancy offers an ideal opportunity to support women towards a healthier lifestyle; however, strategies for reducing weight gain in the non-pregnant population may not be suitable for use in pregnancy. The aim of this review was to determine whether diet or exercise interventions, or both, for preventing excessive weight gain are effective and safe in pregnancy and to stimulate further research in this field.

OBJECTIVES

To evaluate the effectiveness and safety of diet or exercise, or both, interventions for preventing excessive weight gain during pregnancy.

METHODS

Criteria for considering studies for this review

Types of studies

Randomised controlled trials (RCTs) and cluster-RCTs. Quasi-RCTs were not eligible.

Types of participants

Pregnant women of any BMI. We considered studies recruiting women with normal BMIs to have a 'low risk' of weight-related complications at baseline, those recruiting women from the general population including women of any BMI to have a 'mixed-risk' status, and studies of overweight and/or obese women, or high-risk women, as defined by the investigators, to have a 'high-risk' status.

Types of interventions

Any diet or exercise, or both, intervention (e.g. healthy eating plan, low glycaemic diet, exercise intervention, health education, lifestyle counselling) compared with standard or routine care for preventing excessive weight gain in pregnancy. We organised our main comparison into different intervention types, as follows:

- diet counselling only versus routine care;
- diet and exercise counselling versus routine care;
- diet interventions (e.g. low glycaemic diet) versus routine care;
- exercise (supervised or unsupervised) interventions only versus routine care;
- diet and supervised exercise interventions versus routine care.

We defined diet as a special selection of food, or energy intake, to which a participant was restricted. Exercise interventions included any activity requiring physical effort, carried out to sustain or improve health and fitness.

Types of outcome measures

Primary outcomes

Excessive weight gain as defined by investigators.

Secondary outcomes

For the mothers

1. Weight gain.
2. Low weight gain as defined by investigators.
3. Preterm birth.
4. Preterm prelabour rupture of membranes.
5. Pre-eclampsia/eclampsia.
6. Hypertension (not prespecified).
7. Induction of labour.
8. Caesarean delivery.
9. Postpartum complication including postpartum haemorrhage, wound infection, endometritis, need for antibiotics, perineal trauma, thromboembolic disease, maternal death.
10. Behaviour modification outcomes: diet, physical activity.

For the newborns

1. Birthweight (not prespecified).
2. Birthweight greater than 4000 g or greater than the 90th centile for gestational age and infant sex (macrosomia).
3. Birthweight less than 2500 g or less than the 10th centile for gestational age and infant sex.
4. Complication related to macrosomia including hypoglycaemia, hyperbilirubinaemia, infant birth trauma (palsy, fracture, shoulder dystocia), respiratory distress syndrome.

Long-term health outcomes

1. Maternal weight retention postpartum.
2. Childhood weight.

Gestational diabetes, an important outcome of many interventions aimed at preventing excessive weight gain in pregnancy, is the primary outcome of separate Cochrane reviews (Crane 2013; Han 2012; Tieu 2008) and is therefore not included in this review.

Search methods for identification of studies

The following methods section of this review is based on a standard template used by the Cochrane Pregnancy and Childbirth Group.

Electronic searches

We searched the Cochrane Pregnancy and Childbirth Group's Trials Register by contacting the Trials Search Co-ordinator (5 November 2014).

The Cochrane Pregnancy and Childbirth Group's Trials Register is maintained by the Trials Search Co-ordinator and contains trials identified from:

1. monthly searches of the Cochrane Central Register of Controlled Trials (CENTRAL);
2. weekly searches of MEDLINE (Ovid);
3. weekly searches of Embase (Ovid);
4. handsearches of 30 journals and the proceedings of major conferences;
5. weekly current awareness alerts for a further 44 journals plus monthly BioMed Central email alerts.

Details of the search strategies for CENTRAL, MEDLINE and Embase, the list of handsearched journals and conference proceedings, and the list of journals reviewed via the current awareness service can be found in the 'Specialized Register' section within the editorial information about the [Cochrane Pregnancy and Childbirth Group](#).

Trials identified through the searching activities described above are each assigned to a review topic (or topics). The Trials Search Co-ordinator searches the register for each review using the topic list rather than keywords.

Searching other resources

For this update, we also contacted investigators of the previously identified ongoing studies by email to enquire about any new or imminent publications.

We searched the reference lists of retrieved studies.

We did not apply any language or date restrictions.

Data collection and analysis

For methods used in the previous version of this review, see [Muktabhant 2012](#).

For this update, we used the following methods based on a standard template used by the Cochrane Pregnancy and Childbirth Group for assessing the reports that were identified as a result of the updated search.

Selection of studies

Two review authors (Benja Muktabhant (BM); Theresa Lawrie (TL)) independently assessed for inclusion all the potential studies identified as a result of the search strategy. We resolved any disagreement through discussion or, if required, we consulted the third review author (Pisake Lumbiganon (PL)).

Data extraction and management

Using Microsoft Excel®, we designed a spreadsheet to collect study data and piloted it with two studies. Thereafter, two review authors (BM, TL) extracted data from included studies using the piloted form. We resolved discrepancies through discussion or, if required, we consulted a third review author (PL). Data were entered into Review Manager software ([RevMan 2014](#)) by one review author (TL) and checked for accuracy by another (BM).

For studies that reported results for obese and overweight women separately, we combined these data for the 'high-risk women' subgroup.

Assessment of risk of bias in included studies

Two review authors (BM, TL) independently assessed risk of bias for each study using the criteria outlined in the *Cochrane Handbook for Systematic Reviews of Interventions* ([Higgins 2011](#)). Any disagreement was resolved by discussion or by involving a third assessor (PL or Malinee Laopaiboon (ML)).

(1) Random sequence generation (checking for possible selection bias)

We described for each included study the method used to generate the allocation sequence in sufficient detail to allow an assessment of whether it should produce comparable groups.

We assessed the method as:

- low risk of bias (any truly random process, e.g. random number table; computer random number generator);
- high risk of bias (any non-random process, e.g. odd or even date of birth; hospital or clinic record number);
- unclear risk of bias.

(2) Allocation concealment (checking for possible selection bias)

We described for each included study the method used to conceal allocation to interventions prior to assignment and assessed whether intervention allocation could have been foreseen in advance of, or during recruitment, or changed after assignment.

We assessed the methods as:

- low risk of bias (e.g. telephone or central randomisation; consecutively numbered sealed opaque envelopes);
- high risk of bias (open random allocation; unsealed or non-opaque envelopes, alternation; date of birth);
- unclear risk of bias.

(3.1) Blinding of participants and personnel (checking for possible performance bias)

We described for each included study the methods used, if any, to blind study participants and personnel from knowledge of which intervention a participant received. We considered that studies were at low risk of bias if they were blinded, or if we judged that the lack of blinding unlikely to affect results. We assessed blinding separately for different outcomes or classes of outcomes.

We assessed the methods as:

- low, high or unclear risk of bias for participants;

- low, high or unclear risk of bias for personnel.

(3.2) Blinding of outcome assessment (checking for possible detection bias)

We described for each included study the methods used, if any, to blind outcome assessors from knowledge of which intervention a participant received. We assessed blinding separately for different outcomes or classes of outcomes.

We assessed methods used to blind outcome assessment as:

- low, high or unclear risk of bias.

(4) Incomplete outcome data (checking for possible attrition bias due to the amount, nature and handling of incomplete outcome data)

We described for each included study, and for each outcome or class of outcomes, the completeness of data including attrition and exclusions from the analysis. We stated whether attrition and exclusions were reported and the numbers included in the analysis at each stage (compared with the total randomised participants), reasons for attrition or exclusion where reported, and whether missing data were balanced across groups or were related to outcomes. Where sufficient information was reported, or could be supplied by the trial authors, we planned to re-include missing data in the analyses which we undertook.

We assessed methods as:

- low risk of bias (e.g. no missing outcome data; missing outcome data balanced across groups);
- high risk of bias (e.g. numbers or reasons for missing data imbalanced across groups; 'as treated' analysis done with substantial departure of intervention received from that assigned at randomisation);
- unclear risk of bias.

(5) Selective reporting (checking for reporting bias)

We described for each included study how we investigated the possibility of selective outcome reporting bias and what we found.

We assessed the methods as:

- low risk of bias (where it is clear that all of the study's pre-specified outcomes and all expected outcomes of interest to the review have been reported);
- high risk of bias (where not all the study's pre-specified outcomes have been reported; one or more reported primary outcomes were not pre-specified; outcomes of interest are reported incompletely and so cannot be used; study fails to include results of a key outcome that would have been expected to have been reported);
- unclear risk of bias.

(6) Other bias (checking for bias due to problems not covered by (1) to (5) above)

We described for each included study any important concerns we had about other possible sources of bias.

(7) Overall risk of bias

We made explicit judgements about whether studies were at high risk of bias, according to the criteria given in the *Handbook* (Higgins 2011). With reference to (1) to (6) above, we attempted to assess the likely magnitude and direction of the bias and whether we considered it is likely to impact on the findings. We explored the impact of the level of bias through undertaking sensitivity analyses - see [Sensitivity analysis](#).

Measures of treatment effect

Dichotomous data

For dichotomous data, we presented results as summary risk ratios with 95% confidence intervals.

Continuous data

We used the mean difference if outcomes were measured in the same way between trials. We used the standardised mean difference to combine trials that measured the same outcome, but used different methods.

Unit of analysis issues

Cluster-randomised trials

We included cluster-randomised trials in the analyses along with individually-randomised trials provided that cluster-RCT data were adjusted for clustering and any baseline imbalances. We considered it reasonable to combine the results from both if there was little heterogeneity between the study designs and the interaction between the effect of intervention and the choice of randomisation unit was considered to be unlikely. We assessed risk of bias of these trials with particular attention to imbalances in baseline characteristics between the comparison arms, loss of clusters and appropriate analyses, and we acknowledged heterogeneity in the randomisation unit, performing sensitivity analyses to investigate the effects of including these studies on review findings.

Other issues

For studies that included three arms, we divided the control group into two equal groups and considered each comparison separately. If the number of events in the control group was an odd number, to reduce the risk of overestimating effects in favour of the intervention group, we halved it and rounded it down; for odd denominators (total number of participants in the control group), we rounded these numbers upwards for the same reason.

Dealing with missing data

For included studies, we noted levels of attrition. We imputed data for studies where results were incompletely reported, e.g. if percentages and denominators were known, but the number of events was missing. For all outcomes, we carried out, as far as possible, analyses on an intention-to-treat basis, that is, we attempted to include all participants randomised to each group in the analyses. The denominator for each outcome in each trial was the number randomised minus any participants whose outcomes were known to be missing.

Assessment of heterogeneity

We assessed statistical heterogeneity in each meta-analysis using the Tau², I² and Chi² statistics. We regarded heterogeneity as

substantial if an I^2 was greater than 30% and either a Tau^2 was greater than zero, or there was a low P value (less than 0.10) in the Chi^2 test for heterogeneity. If we identified heterogeneity above 30%, we explored it by sensitivity and subgroup analyses.

Assessment of reporting biases

Where there were 10 or more studies in the meta-analysis, we investigated reporting biases (such as publication bias) using funnel plots, which we assessed visually for asymmetry. If asymmetry was suggested by a visual assessment, we performed exploratory analyses to investigate it.

Data synthesis

We carried out statistical analysis using the Review Manager software (RevMan 2014). We used random-effects meta-analysis to produce an overall summary, if an average treatment effect across trials was considered clinically meaningful. The random-effects summary was treated as the average of the range of possible treatment effects and we considered the clinical implications of treatment effects differing between trials. If the average treatment effect was not clinically meaningful, we did not combine trials. The results of these random-effects analyses are presented as the average treatment effect with 95% confidence intervals and estimates of I^2 .

Subgroup analysis and investigation of heterogeneity

Subgroup analyses according to risk were not specified in the original review protocol. We conducted subgroup analyses according to the risk of adverse effects related to poor weight control with the high-risk group comprising only overweight and obese women, or women with or at risk of diabetes mellitus; a mixed-risk group comprising women in the general population, including women of any body mass indices (BMIs), and a low-risk group comprising normal weight women or women with BMIs of less than 25 kg/m². Where possible, we performed subgroup analysis for the following outcomes.

1. Excessive gestational weight gain (GWG)
2. Mean GWG
3. Low GWG
4. Preterm birth
5. Caesarean section
6. Pre-eclampsia
7. Macrosomia

For these analyses, we assessed subgroup differences by interaction tests available within RevMan (RevMan 2014) and reported the results of subgroup analyses quoting the Chi^2 statistic and P value, and the interaction test I^2 value.

We explored heterogeneity by organising studies within comparisons according to the types of interventions.

Sensitivity analysis

We carried out sensitivity analyses to explore the effect of trial quality by excluding studies with risk of bias concerns from the analyses in order to assess whether this made any difference to the overall result.

Quality of evidence

Following meta-analysis, the quality of the evidence was assessed using the GRADE approach (Schunemann 2009) for the following key outcomes.

1. Excessive GWG
2. Mean GWG
3. Low GWG
4. Preterm birth
5. Caesarean section
6. Pre-eclampsia
7. Macrosomia

'Summary of findings' tables were created using this feature in RevMan 2014 with a summary of the intervention effect and a measure of quality produced for each of the above outcomes using the GRADE approach (GRADE 2014). The GRADE approach uses five considerations to assess the quality of the body of evidence for each outcome. We downgraded the evidence from 'high quality' by one level for serious (or by two levels for very serious) limitations, depending on assessments for risk of bias, indirectness of evidence, serious inconsistency, imprecision of effect estimates or potential publication bias.

RESULTS

Description of studies

See [Characteristics of included studies](#); [Characteristics of excluded studies](#); [Characteristics of studies awaiting classification](#); [Characteristics of ongoing studies](#).

Results of the search

The original search identified 63 potential studies, of which we included 28 and excluded 12 studies in the original review (Muktabant 2012). Two studies remained unclassified and 21 studies were ongoing.

Searches updated to November 2014 identified 169 eligible records. Of these 169 records, we included 102 records (pertaining to 41 new RCTs), and excluded 19 records (pertaining to 10 new studies, and one previously excluded study). Twelve of the 169 records were new reports of five previously included RCTs (Barakat 2011; Callaway 2010; Laitinen 2009; Luoto 2011; Phelan 2011), 36 records were of ongoing RCTs, and one record remained unclassified for this update (requiring translation from Farsi).

For this update, we excluded two previously included quasi-RCTs (Bechtel-Blackwell 2002; Moses 2006) and two RCTs that involved anti-suppressant drugs (Boileau 1968; Silverman 1971), which had previously been included under a broader title (see [Differences between protocol and review](#)).

Therefore, in summary, we included a total of 65 RCTs in this update (41 new and 24 previously included). Forty-nine studies (29 newly included) contributed data to quantitative synthesis. Twelve RCTs that had been identified as ongoing in the previous review have now been published, leaving 40 ongoing RCTs altogether (including new and previously included ongoing trials not yet reported) for this update ([Characteristics of ongoing studies](#)).

Included studies

Out of 65 included studies, two studies were cluster-RCTs (Luoto 2011; Rauh 2013); all other studies were RCTs. We were able to adjust data for one cluster-RCT (Luoto 2011; Appendix 1) and used adjusted data in meta-analyses, however we were unable to adjust data from Rauh 2013, which therefore did not contribute to meta-analyses. Seven RCT reports were conference abstracts (Angel 2011; Bisson 2014; Bogaerts 2012; Leiferman 2011; Marcinkevage 2012; Mujsindi 2014; Szmaja 2011). One of these studies (Leiferman 2011), also generated a substudy in the form of a PhD thesis (Nodine 2011), which we have linked to this study in the references section. When reported in full, these seven RCTs may yet contribute data to future versions of this review; however, in general, we gleaned very little methodological information and no usable data from the abstracts. We have included information about these trials in the [Characteristics of included studies](#) tables, but they are not otherwise discussed in the sections below.

Participants

Two studies (Bogaerts 2012; Leiferman 2011) did not report the number of participants. The remaining 63 included studies involved at least 13,523 pregnant participants, and the number of participants in each study ranged from 12 (Magee 1990) to more than 2000 (Dodd 2014). Fifty-five out of 65 studies reported age and body mass index (BMI) at baseline and these were similar between study and control groups, with a few exceptions (see [Risk of bias in included studies](#)). Four studies recruited only nulliparous women (Althuisen 2013; Haakstad 2011; Murtezani 2014; Pinzon 2012). Most studies recruited women less than 20 weeks' gestation (48/65; 74%), with 27/65 (42%) studies recruiting women less than or equal to 14 weeks' gestation. Thirteen studies recruited participants after 20 weeks' gestation, namely Rhodes 2010 (13 to 28 weeks); Ferrara 2011 (approximately 31 weeks on average); Louie 2011 (20 to 32 weeks); Angel 2011 (more than 20 weeks); Hui 2012, Hui 2006 and Jackson 2011 (up to 26 weeks); Magee 1990 (13 to 38 weeks); Moses 2009 (approximately 30 weeks on average); Pollak 2014 (up to 21 weeks); Stafne 2012 (18 to 22 weeks); Thornton 2009 (12 to 28 weeks); Vitolo 2011 (10 to 29 weeks). Gestation at recruitment was not clear for the remainder (Bogaerts 2012; Leiferman 2011; Mujsindi 2014; Quinlivan 2011).

Studies included participants of various weight categories with 'normal weight' generally defined as a BMI greater than 18 and less than 25 kg/m², 'overweight' was considered to be greater than or equal to 25 kg/m² and less than 30 kg/m², and 'obese' was considered to be a BMI of greater than or equal to 30 kg/m². Thirty-four studies recruited women from the 'general population' (i.e. of various BMIs) and the proportion of women with normal BMIs varied widely across study samples reporting this baseline characteristic, from 15% to 79% of participants. Most of these studies did not report results for high- (overweight/obese women) and low-risk (normal BMI) women separately; however, for eight of these studies (Althuisen 2013; Hui 2014; Jeffries 2009; Phelan 2011; Polley 2002; Ronnberg 2014; Ruiz 2013; Vitolo 2011), main outcomes were reported separately for women with low/normal versus overweight/obese prepregnancy weights; therefore, where possible, we used relevant data from these studies for meta-analyses pertaining to low, mixed-risk and high-risk groups. One study (ROLO 2012) recruited only secundigravid women who had previously given birth to a baby with macrosomia and reported certain outcomes separately for women in all weight categories.

Among 31 studies recruiting women in high-risk groups, 24 studies recruited overweight and obese women, or obese women only (Angel 2011; Bisson 2014; Bogaerts 2012; Callaway 2010; Dodd 2014; Guelinckx 2010; Kong 2014; Magee 1990; Marcinkevage 2012; Mujsindi 2014; Nascimento 2012; Oostdam 2012; Petrella 2013; Poston 2013; Pollak 2014; Quinlivan 2011; Renault 2014; Rhodes 2010; Santos 2005; Szmaja 2011; Thornton 2009; Vesco 2013; Vinter 2012; Wolff 2008); and seven recruited women with, or defined as at high risk of, gestational diabetes (Ferrara 2011; Harrison 2013; Korpi-Hyovalti 2011; Louie 2011; Luoto 2011; Moses 2009; Rae 2000).

Settings

Most studies were conducted in high-income countries, including Australia (Callaway 2010; Dodd 2014; Harrison 2013; Jeffries 2009; Louie 2011; Moses 2009; Moses 2014; Quinlivan 2011; Szmaja 2011; Wilkinson 2012), Belgium (Bogaerts 2012; Guelinckx 2010), Canada (Hui 2006; Hui 2012; Hui 2014; Hui 2014; Ruchat 2012), Denmark (Renault 2014; Vinter 2012; Wolff 2008), Finland (Korpi-Hyovalti 2011; Laitinen 2009; Luoto 2011), Germany (Rauh 2013), Ireland (ROLO 2012), Italy (Di Carlo 2014; Petrella 2013), Kosovo (Murtezani 2014), Norway (Haakstad 2011), Sweden (Petrov Fieril 2014; Ronnberg 2014), The Netherlands (Althuisen 2013; Oostdam 2012), Spain (Barakat 2011; Cordero 2014; Ruiz 2013), the United Kingdom (Poston 2013) and the United States of America (USA) (Angel 2011; Asbee 2009; Bisson 2014; Clapp 2002a; Clapp 2002b; Ferrara 2011; Hawkins 2014; Kieffer 2014; Kong 2014; Leiferman 2011; Magee 1990; Marcinkevage 2012; Mujsindi 2014; Phelan 2011; Pollak 2014; Polley 2002; Price 2012; Rhodes 2010; Thornton 2009; Vesco 2013). Two of these studies (Hui 2006; Polley 2002) recruited women with low-, or low-middle incomes in Canada and the USA, respectively. Of the six studies conducted in low-income countries, four were conducted in Brazil (De Oliveria Melo 2012; Nascimento 2012; Santos 2005; Vitolo 2011), one was conducted in Columbia (Pinzon 2012) and one was conducted in Taiwan (Huang 2011).

Interventions

All the interventions considered in this review included modifying or restricting diet or increasing exercise, or both; however there was considerable variation in the interventions used, which included:

- diet only (eight studies): low glycaemic load (GL) diet versus conventional healthy eating or routine or other care: Angel 2011; Clapp 2002a; Louie 2011; Moses 2009; Moses 2014; Rhodes 2010; ROLO 2012; one study evaluated a supervised low calorie diet (Magee 1990);
- diet and exercise counselling (25 studies): Asbee 2009; Althuisen 2013; Bogaerts 2012; Dodd 2014; Ferrara 2011; Guelinckx 2010; Harrison 2013; Hawkins 2014; Huang 2011; Jackson 2011; Kieffer 2014; Korpi-Hyovalti 2011; Luoto 2011; Marcinkevage 2012; Mujsindi 2014; Petrella 2013; Phelan 2011; Pollak 2014; Polley 2002; Quinlivan 2011; Rauh 2013; Renault 2014; Szmaja 2011; Vesco 2013; Wilkinson 2012;
- exercise interventions (e.g. supervised exercise, individualised exercise programs, dance classes, provision of pedometers or treadmills) (20 studies): Barakat 2011; Bisson 2014; Callaway 2010; Clapp 2002b; Cordero 2014; De Oliveria Melo 2012; Haakstad 2011; Kong 2014; Leiferman 2011; Murtezani 2014; Nascimento 2012; Oostdam 2012; Petrov Fieril 2014; Pinzon 2012; Poston 2013; Price 2012; Renault 2014; Ruiz 2013; Ronnberg 2014; Santos 2005;

- diet and supervised exercise interventions (five studies): [Hui 2006](#); [Hui 2012](#); [Hui 2014](#); [Ruchat 2012](#); [Vinter 2012](#);
- diet counselling/other (seven studies): [Di Carlo 2014](#); [Jeffries 2009](#); [Laitinen 2009](#); [Rae 2000](#); [Thornton 2009](#); [Vitolo 2011](#); [Wolff 2008](#).

Interventions varied in intensity. Control groups mostly comprised routine or standard care (which also varied considerably in different settings and was not always well-described). [Hui 2006](#) compared a supervised group exercise and diet intervention with an exercise and diet information pack. [Clapp 2002b](#) compared different exercise intensities at different stages of pregnancy. Some studies included more than two arms ([De Oliveria Melo 2012](#); [Laitinen 2009](#); [Guelinckx 2010](#); [Renault 2014](#)).

Outcomes

Gestational weight gain (GWG) or excessive GWG, or both, were reported as primary or secondary outcomes in 75% of included studies. Excessive GWG was usually defined according to prevailing IOM guidelines. Generally, baseline weight was measured at recruitment; however, several studies used self-reported prepregnancy weight as the baseline measurement (e.g. [Di Carlo 2014](#); [Haakstad 2011](#); [Hui 2012](#); [Louie 2011](#); [Moses 2014](#); [Oostdam 2012](#)). The final weight measurement was either collected by researchers at the last clinic or hospital visit (usually greater than or equal to 36 weeks) or from medical records. Several studies collected these follow-up weight data earlier than 36 weeks, including [Vesco 2013](#) (34 weeks), [Oostdam 2012](#) (32 weeks), [Harrison 2013](#) (28 weeks), and [Petrov Fieril 2014](#) (25 weeks). The latter study included mean weight as an outcome, but not mean weight gain.

Other reported outcomes included postpartum weight retention, macrosomia, infant birthweight, gestational diabetes, pre-eclampsia/hypertension, diet and physical activity (PA) behaviour, breastfeeding, biochemical parameters, e.g. serum insulin levels, and various other maternal and neonatal outcomes.

Excluded studies

Initially, we excluded 26 studies (12 previously excluded, 10 new excluded and four previously included). One previously excluded study ([Moses 2007](#)), was a follow-up of a previously included study ([Moses 2006](#)) and these two reports are now listed together, reducing the number of excluded studies to 25 studies. The main reasons for exclusion were as follows.

1. Non-randomised study or quasi-RCT: [Bechtel-Blackwell 2002](#); [Breslow 1963](#); [Daley 2014](#); [Davenport 2011](#); [Graham 2014](#); [Gray-Donald 2000](#); [Kinnunen 2007](#); [Maitland 2014](#); [Mohebi 2009](#); [Moses 2006](#); [Mottola 2010](#); [Olson 2004](#); [Stutzman 2010](#); [Walker 1966](#).
2. Participants included non-pregnant or postpartum women: [Campbell 2004](#); [Faucher 2008](#); [Hausenblas 2008](#); [Te Morenga 2011](#); [Wisner 2006](#).
3. Not a diet or exercise intervention: [Asemi 2011](#); [Boileau 1968](#); [Hauner 2012](#); [Ismail 1990](#); [Lindsay 2014](#); [Silverman 1971](#).

Risk of bias in included studies

Details of the methodological quality of each study are given in [Characteristics of included studies](#), [Figure 1](#), and [Figure 2](#). Studies were considered to be potentially at a moderate-to-high risk of bias if they were assessed to be at 'high risk' for at least one of the risk of bias items below, excluding blinding, as most studies were open-label. We considered 35/65 studies (54%) to be at a low risk of bias overall, and 20/65 (29%) to be at a moderate-to-high risk of bias overall ([Asbee 2009](#); [Barakat 2011](#); [Callaway 2010](#); [Cordero 2014](#); [Di Carlo 2014](#); [Ferrara 2011](#); [Luoto 2011](#); [Murtezani 2014](#); [Nascimento 2012](#); [Oostdam 2012](#); [Petrov Fieril 2014](#); [Pinzon 2012](#); [Price 2012](#); [Rauh 2013](#); [Ruchat 2012](#); [Santos 2005](#); [Stafne 2012](#); [Vitolo 2011](#); [Wilkinson 2012](#); [Wolff 2008](#)). Five of the latter studies ([Callaway 2010](#); [Pinzon 2012](#); [Rauh 2013](#); [Vitolo 2011](#); [Wilkinson 2012](#)) did not contribute to quantitative analysis in this update. The remaining 10 studies were at an unclear risk of bias ([Angel 2011](#); [Bisson 2014](#); [Bogaerts 2012](#); [Korpi-Hyovalti 2011](#); [Leiferman 2011](#); [Magee 1990](#); [Marcinkevage 2012](#); [Mujsindi 2014](#); [Polley 2002](#); [Szmeja 2011](#)).

Figure 1. Methodological quality summary: review authors' judgements about each methodological quality item for each included study.

	Random sequence generation (selection bias)	Allocation concealment (selection bias)	Blinding of participants and personnel (performance bias)	Blinding of outcome assessment (detection bias)	Incomplete outcome data (attrition bias)	Selective reporting (reporting bias)	Other bias
Althuisen 2013	+	?	-	?	?	?	+
Angel 2011	?	?	?	?	?	?	?
Asbee 2009	+	+	?	?	+	+	-
Barakat 2011	+	?	?	?	?	?	-
Bisson 2014	?	?	?	?	?	?	?
Bogaerts 2012	?	?	?	?	?	?	?
Callaway 2010	+	?	-	?	-	?	?
Clapp 2002a	?	?	?	?	?	-	?
Clapp 2002b	?	?	?	-	+	?	+
Cordero 2014	?	?	-	?	-	-	-
De Oliveria Melo 2012	+	+	-	+	?	?	+
Di Carlo 2014	?	+	-	+	-	-	-
Dodd 2014	+	+	-	+	+	+	+
Ferrara 2011	+	?	-	+	-	?	+
Guelinckx 2010	?	+	?	?	+	?	+
Haakstad 2011	+	+	+	+	+	?	?
Harrison 2013	+	?	+	+	+	?	?
Hawkins 2014	+	?	?	+	+	?	+
Huang 2011	+	?	?	+	?	?	+
Hui 2006	?	?	?	?	?	?	+

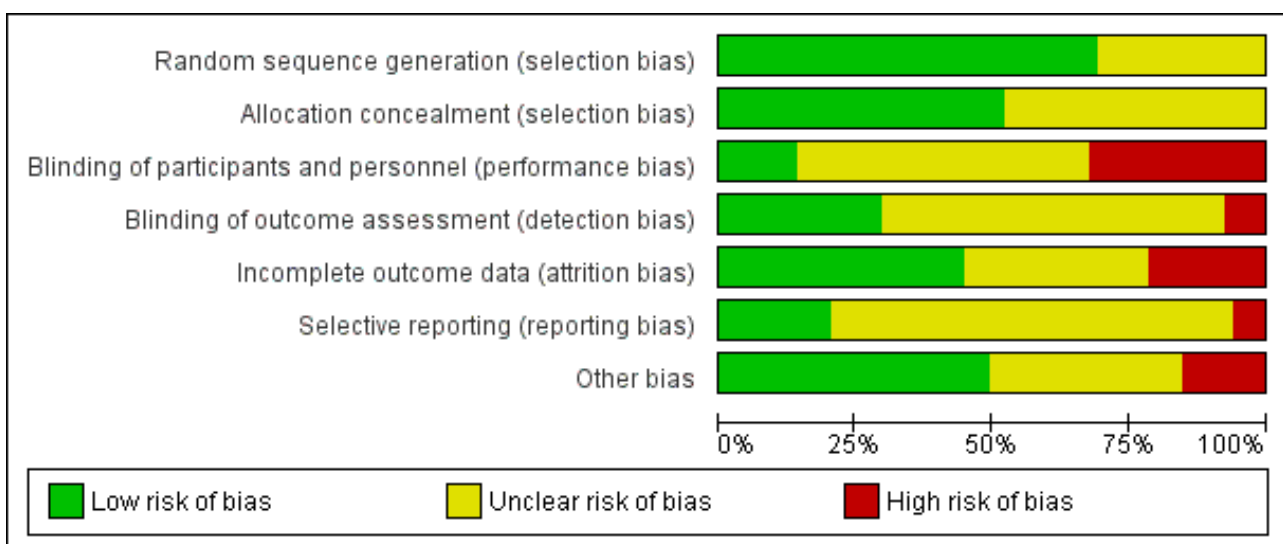
Figure 1. (Continued)

Hui 2006	?	?	?	?	?	?	+
Hui 2012	+	+	-	-	?	?	+
Hui 2014	+	+	-	+	+	?	+
Jackson 2011	+	+	?	?	+	?	?
Jeffries 2009	+	+	+	?	+	+	+
Kieffer 2014	+	+	?	+	+	?	+
Kong 2014	+	?	-	?	?	+	?
Korpi-Hyovalti 2011	+	?	?	?	?	?	?
Laitinen 2009	+	+	+	?	+	+	+
Leiferman 2011	?	?	?	?	?	?	?
Louie 2011	+	+	+	+	+	+	+
Luoto 2011	+	+	-	?	-	?	?
Magee 1990	?	?	?	?	?	?	?
Marcinkevage 2012	?	?	?	?	?	?	?
Moses 2009	+	?	?	?	+	?	+
Moses 2014	?	?	-	+	+	+	+
Mujisindi 2014	?	?	?	?	?	?	?
Murtezani 2014	+	?	?	?	?	-	-
Nascimento 2012	+	+	?	?	?	+	?
Oostdam 2012	+	+	-	+	-	+	-
Petrella 2013	+	+	-	-	+	+	+
Petrov Fieril 2014	?	+	-	+	-	?	+
Phelan 2011	+	+	?	+	+	?	?
Pinzon 2012	+	+	+	+	-	?	+
Pollak 2014	?	?	?	?	+	?	+
Polley 2002	?	?	?	?	+	?	?
Poston 2013	+	+	?	?	+	?	+
Price 2012	?	+	-	-	-	?	-
Quinlivan 2011	+	+	?	+	+	?	?
Rae 2000	?	+	+	?	+	?	+
Rauh 2013	+	+	-	-	?	?	-

Figure 1. (Continued)

Rauh 2013	+	+	-	-	?	?	-
Renault 2014	+	+	-	?	+	?	+
Rhodes 2010	+	+	+	?	?	?	+
ROLO 2012	+	+	?	?	+	?	+
Ronnberg 2014	+	+	-	?	+	?	?
Ruchat 2012	+	?	?	?	-	?	-
Ruiz 2013	+	?	?	?	?	+	+
Santos 2005	+	+	-	+	-	?	-
Stafne 2012	+	+	-	+	-	?	+
Szmeja 2011	?	?	?	?	?	?	?
Thornton 2009	+	+	?	?	+	?	+
Vesco 2013	+	?	?	?	+	+	?
Vinter 2012	+	+	?	?	+	+	+
Vitolo 2011	+	?	?	?	+	?	?
Wilkinson 2012	+	+	?	?	-	?	+
Wolff 2008	+	?	+	?	-	?	+

Figure 2. Methodological quality graph: review authors' judgements about each methodological quality item presented as percentages across all included studies.



Allocation

Out of 65 studies, 45 (69%) were assessed as being at low risk of bias for generation of the randomisation sequence and 34 (52%) used

methods that we judged to be at a low risk of bias for allocation concealment. The remaining studies (25%) were at an unclear risk of selection bias.

Blinding

Twenty-four out of 65 studies (37%) had taken some steps to implement performance or detection blinding, or both. Achieving participant and personnel blinding of treatment allocation for diet and exercise interventions was indicated to be not feasible in several studies and was not described in many others. Where studies were described as open-label or unblinded, we classified these as at a high risk of bias for this item; however, it was difficult to ascertain whether the lack of blinding, or unsuccessful blinding, impacted on outcomes or resulted in any systematic bias. In addition, the studies that did not describe blinding were probably unblinded. For these reasons we did not use blinding as a criterion in the overall assessment of individual study bias but rather took into account other types of bias.

Incomplete outcome data

We assessed 29/65 studies (45%) to be at a low risk of attrition bias. Fourteen studies (22%) ([Callaway 2010](#); [Cordero 2014](#); [Di Carlo 2014](#); [Ferrara 2011](#); [Luoto 2011](#); [Oostdam 2012](#); [Petrov Fieril 2014](#); [Pinzon 2012](#); [Price 2012](#); [Ruchat 2012](#); [Santos 2005](#); [Stafne 2012](#); [Wilkinson 2012](#); [Wolff 2008](#)) had high attrition (greater than 20%) overall, or for the intervention or control group only, or for certain outcomes, and we considered these to be at a high risk of bias accordingly. In the remaining studies, loss of outcome data was either not stated or was less than 20% but there were other concerns (e.g. imbalance in attrition between arms) and for these we considered the risk of bias to be unclear.

Selective reporting

It was difficult to assess bias associated with the outcome reporting bias as we did not have access to the study protocols of most studies and we did not know whether results for all outcomes where data had been collected had been reported; we therefore assessed many of these studies as being unclear for the outcome reporting bias. However, we considered [Cordero 2014](#) and [Di Carlo 2014](#) to be at a potentially high risk of reporting bias as only per protocol findings were reported. During the course of these studies, women with preterm labour were excluded, therefore, this potential side-effect could not be evaluated. In addition, [Cordero 2014](#) additionally excluded data from women with poor adherence to the intervention; therefore, the reported results may be biased in the direction of the intervention.

Other potential sources of bias

Six studies had important baseline imbalances in the characteristics of the women in the intervention and control groups ([Barakat 2011](#); [Cordero 2014](#); [Di Carlo 2014](#); [Price 2012](#); [Rauh 2013](#); [Santos 2005](#)) that might have impacted the results in favour of the intervention. [Barakat 2011](#), [Cordero 2014](#), [Di Carlo 2014](#) and [Price 2012](#) did not adjust results for these imbalances and we therefore considered them to be at a potentially high risk of bias. [Cordero 2014](#) additionally had an unexplained difference in intervention and control group sizes. [Rauh 2013](#) is discussed below under 'Assessment of cluster-RCTs'.

In [Price 2012](#), control participants were told not to exercise because it would blur the distinction between the groups. This contributed to high drop-out rates in the control group and bias in favour of the intervention, whilst making results less applicable by enforcing no exercise. [Oostdam 2012](#) had issues with adherence to the

intervention, which may have biased results in favour of the control group.

Most studies involving an exercise component excluded women at risk of miscarriage or preterm birth at screening. However, four studies excluded women with or at risk of preterm birth post-randomisation from analysis ([Cordero 2014](#); [Di Carlo 2014](#); [Murtezani 2014](#); [Rauh 2013](#)). This omission might have led to publication bias in the review's 'preterm birth' outcome. Any other potential sources of bias were noted in the [Characteristics of included studies](#).

Assessment of cluster-RCTs

Two trials were cluster-RCTs ([Luoto 2011](#); [Rauh 2013](#)).

Recruitment bias: In [Rauh 2013](#), intervention and control groups differed substantially in size as "During recruitment it turned out that it was easier to recruit women for the intervention group than for the control group, yielding a 2:1 ratio", instead of 1:1. In [Luoto 2011](#), more than 20% and 30% in the intervention and control arms, respectively, were excluded from analysis based on oral glucose tolerance tests conducted between eight and 12 weeks' gestation. Only 40% and 47% of women in intervention and control groups, respectively, who were assessed as preliminary eligible were analysed.

Baseline imbalances: Baseline imbalances were limited to differences in educational levels between arms in [Luoto 2011](#). However, in [Rauh 2013](#), baseline characteristics differed significantly with regard to pregravid BMI ($P = 0.003$) and BMI at booking ($P = 0.008$), with a higher proportion of women in the control group considered obese or overweight (16.2% versus 31.4%; $P = 0.009$). In addition, mean age was younger and gestational age at booking was significantly earlier in the intervention clusters.

Loss of clusters: There was no loss of clusters in either study.

Analysis methods: Both [Luoto 2011](#) and [Rauh 2013](#) reported adjusting the summary effect size for clusters and baseline imbalances. However, outcome data for both studies needed to be estimated for use in meta-analysis, and this was not possible for [Rauh 2013](#), due to insufficient data and the lack of an intracluster correlation coefficient. The results reported in [Rauh 2013](#) favoured the intervention arm for weight gain outcomes ([Appendix 2](#)), and although these were adjusted for BMI, age and clustering, there may also have been other (unknown) differences between the women in these groups. We therefore considered this study to be at potentially high risk of bias; however, [Rauh 2013](#) data did not contribute to meta-analyses.

Comparability with individually-randomised trials: These trials were comparable to individually-randomised trials except that large differences in study group sizes occurred in [Rauh 2013](#). Study investigators reported that the clusters (gynaecology practices) differed significantly in size; the result was that 227 versus 129 women were eligible for the intervention and control clusters, respectively.

Overall assessment: We assessed these cluster-RCTs as moderate-to-high risk of bias. Adjusted [Luoto 2011](#) data were used in meta-analyses; however, [Rauh 2013](#) data could not be adjusted and were therefore not used.

Effects of interventions

See: [Summary of findings for the main comparison All diet and/or exercise interventions compared to standard/other care for preventing excessive weight gain in pregnancy](#); [Summary of findings 2 Comparative table of findings by intervention type](#)

We compared diet or exercise, or both, interventions together (comparisons 1) organised by types of interventions (see [Table 1](#) for the rationale for study categories). We also analysed each intervention category separately stratified for risk (comparisons 2, 3, 4, and 5) for all women (i.e. a mixed-risk population), low risk, and high-risk women.

1. Diet and/or exercise interventions vs routine care in all pregnant women

Forty-nine studies involving 11,444 participants contributed data to these analyses. A maximum of 36 studies contributed data to Comparison 1 analyses. Funnel plots were asymmetrical for most analyses.

1.1 Excessive gestational weight gain (GWG)

Diet or exercise, or both, interventions resulted in an average risk reduction of excessive GWG of 20% in favour of the intervention group (risk ratio (RR) 0.80, 95% confidence interval (CI) 0.73 to 0.87; participants = 7096; studies = 24; $I^2 = 52%$; [Analysis 1.1](#)). Reductions in favour of the intervention arms were consistent across the different types of intervention groups, except for the heterogeneous group comprising 'diet counselling or other interventions', with the largest reduction occurring with 'supervised exercise and diet' interventions.

Sensitivity analysis

When we removed five studies with risk of bias concerns from the meta-analysis ([Cordero 2014](#); [Di Carlo 2014](#); [Ferrara 2011](#); [Hui 2006](#); [Ruchat 2012](#)), heterogeneity was reduced and the average overall effect in favour of the intervention group was robust to the original result (RR 0.82, 95% CI 0.76 to 0.89; participants = 6437; studies = 19; $I^2 = 40%$). In addition, when we pooled data from exercise only interventions (supervised and unsupervised), findings were similar (RR 0.79, 95% CI 0.70 to 0.89; participants = 1901; studies = six; $I^2 = 0%$).

Quality of the evidence

We graded this evidence as high quality.

1.2 Mean gestational weight gain (GWG)

Thirty-six studies reported this outcome; however, due to substantial heterogeneity we did not pool these data ([Analysis 1.2](#)). Thirteen studies reported significant differences in mean GWG between intervention and control groups in favour of the interventions, with five studies reporting mean differences in GWG in excess of 5 kg ([Clapp 2002a](#); [Di Carlo 2014](#); [Thornton 2009](#); [Quinlivan 2011](#); [Wolff 2008](#)). The remainder of studies found no significant difference in mean GWG between groups.

1.3 Low weight gain

Women in the intervention group were significantly more likely to experience low GWG compared with the control group (average RR 1.14, 95% CI 1.02 to 1.27; participants = 4422; studies = 11; $I^2 = 3%$; [Analysis 1.3](#)). Results according to types of interventions were

not statistically significant, with wide confidence intervals and a consistent trend in favour of the control group. However, when data from the supervised and unsupervised exercise groups were combined the effect was of borderline statistical significance (RR 1.19, 95% CI 1.00 to 1.41; participants = 1565; studies = four; $I^2 = 0%$).

Sensitivity analysis

There were no serious risk of bias concerns for this analysis.

Quality of the evidence

We graded this evidence as moderate quality.

1.4 Preterm birth

There was no statistically significant difference between intervention and control groups for preterm birth outcomes (average RR 0.91, 95% CI 0.68 to 1.22; participants = 5923; studies = 16; $I^2 = 16%$; [Analysis 1.4](#)). Point estimates for exercise only interventions favoured the control groups; however, when data from the supervised and unsupervised groups were combined the trend was not statistically significant (RR 1.59, 95% CI 0.76 to 3.33; participants = 1358; studies = five; $I^2 = 0%$).

Sensitivity analysis

When two studies with risk of bias concerns were excluded from the analysis ([Price 2012](#); [Petrella 2013](#)), results were similar to the original analysis (average RR 0.88, 95% CI 0.70 to 1.10; participants = 5800; studies = 14; $I^2 = 0%$).

Quality of the evidence

We downgraded this evidence to moderate quality due to risk of bias concerns arising from potential under-reporting (in at least four studies, women at risk of preterm birth were withdrawn; see [Risk of bias in included studies](#)).

1.5 Pre-eclampsia

There was no statistically significant difference between the intervention and control groups with regard to pre-eclampsia (average RR 0.95, 95% CI 0.77 to 1.16; participants = 5330; studies = 15; $I^2 = 0%$; [Analysis 1.5](#)).

Quality of the evidence

We graded the quality of this evidence as high.

1.6 Hypertension (not prespecified)

Maternal hypertension occurred significantly more frequently in the control group compared with the intervention group (average RR 0.70, 95% CI 0.51 to 0.96; participants = 5162; studies = 11; $I^2 = 43%$; [Analysis 1.6](#)).

Sensitivity analysis and investigation of heterogeneity

When we excluded three studies ([Petrella 2013](#); [Price 2012](#); [Stafne 2012](#)) with risk of bias concerns, the result remained in favour of the interventions; however it was no longer statistically significant (RR 0.74, 95% CI 0.53 to 1.02; participants = 4314; studies = eight; $I^2 = 44%$). Heterogeneity could not be attributed to differences between the different types of interventions. We investigated heterogeneity further below, by subgrouping studies by participant risk group.

Quality of the evidence

We downgraded the evidence to low quality due to inconsistency and risk of bias concerns.

1.7 Induction of labour

There was no statistically significant difference between intervention and control groups for this outcome (average RR 1.06, 95% CI 0.94 to 1.19; participants = 3832; studies = eight; $I^2 = 9\%$; [Analysis 1.7](#)).

Quality of the evidence

We graded the quality of this evidence as high.

1.8 Caesarean delivery

There was no statistically significant difference in the risk of caesarean section between intervention and control groups (average RR 0.95, 95% CI 0.88 to 1.03; participants = 7534; studies = 28; $I^2 = 9\%$; [Analysis 1.8](#)); although the point estimate favoured a small reduction in favour of the intervention group. Effect estimates for supervised and unsupervised exercise interventions only, alone or combined, were robust to the overall findings. However, for the diet and exercise counselling interventions, the effect estimate approached statistical significance with a 13% reduction in caesarean delivery in the intervention group (RR 0.87, 95% CI 0.75 to 1.01; participants = 3406; studies = 9; $I^2 = 15\%$; $P = 0.06$).

Sensitivity analysis

When we excluded two studies with risk of bias concerns ([Di Carlo 2014](#); [Price 2012](#)), the results moved further toward the null (average RR 0.97, 95% CI 0.91 to 1.04; participants = 7323; studies = 26; $I^2 = 2\%$).

Quality of the evidence

We graded the quality of this evidence as high, although effects may differ according to types of interventions.

1.9 and 1.10 Maternal postpartum weight retention (mean [kg] and rate)

Diet or exercise, or both, interventions on average were not associated with less postpartum weight retention in kilograms compared with the controls (average mean difference (MD) -1.12, 95% CI -2.49 to 0.25; participants = 818; studies = 7; $I^2 = 55\%$; [Analysis 1.9](#)); however, pooled data from five studies indicated significantly lower rates of postpartum weight retention in the intervention group (average RR 0.78, 95% CI 0.63 to 0.97; participants = 902; studies = five; $I^2 = 63\%$, [Analysis 1.10](#)).

Sensitivity analysis and investigation of heterogeneity

Time frames for these assessments ranged from six weeks to six months postpartum which may have accounted for the heterogeneity. Several studies had risk of bias concerns (mainly attrition bias) for these outcomes; therefore, we did not perform sensitivity analysis.

Quality of the evidence

We graded this evidence as low quality due to inconsistency and risk of bias concerns.

1.11 to 1.13 Behaviour modification outcomes (diet and physical activity)

Energy and fibre intake

Data on mean energy intake were available for 12 studies and revealed a statistically significant difference in energy intake (in kilojoules) between intervention and control groups (average MD -570.77, 95% CI -894.28 to -247.26; participants = 4065; studies = 12; $I^2 = 73\%$; [Analysis 1.11](#)). Similarly, fibre intake in grams was significantly higher in the intervention group (MD 1.53, 95% CI 0.94 to 2.12; participants = 3466; studies = 8; $I^2 = 0\%$; [Analysis 1.12](#)).

Physical activity score at 26 to 29 weeks

Women in the intervention group revealed higher physical activity scores on average compared with controls (average standardised mean difference (SMD) 0.40, 95% CI 0.18 to 0.61; participants = 2851; studies = 9; $I^2 = 75\%$; [Analysis 1.13](#)).

Quality of evidence

We graded evidence relating to behaviour modification outcomes as low quality due to heterogeneity and risk of bias concerns, particularly detection (mainly self-reported outcomes) and attrition bias.

1.14 Infant birthweight greater than 4000 g

There was no statistically significant difference in the risk of macrosomia (birthweight greater than 4000 g) between intervention and control groups overall (average RR 0.93, 95% CI 0.86 to 1.02; participants = 8598; studies = 27; $I^2 = 0\%$, [Analysis 1.14](#)), although the trend favoured the intervention groups. For the 'supervised exercise' intervention group, the effect in favour of the intervention bordered on statistical significance (average RR 0.81, 95% CI 0.64 to 1.02; participants = 2445; studies = seven; $I^2 = 0\%$; $P = 0.07$), but not when supervised and unsupervised exercise interventions were combined (RR 0.87, 95% CI 0.71 to 1.07; participants = 2674; studies = nine; $I^2 = 0\%$).

Sensitivity analysis

Results were similar when we performed sensitivity analysis by excluding seven studies ([Cordero 2014](#); [Ferrara 2011](#); [Luoto 2011](#); [Murtezani 2014](#); [Stafne 2012](#); [Ruchat 2012](#)) with risk of bias concerns from the analysis (average RR 0.92, 95% CI 0.82 to 1.04; participants = 7021; studies = 20; $I^2 = 11\%$).

Quality of the evidence

We graded the evidence as high, although further research may reveal important differences between intervention types.

1.15 Infant birthweight greater than 90th centile

There was no statistically significant difference in the risk of large-for-gestational-age infants between intervention and control groups (average RR 0.92, 95% CI 0.80 to 1.05; participants = 4525; studies = 18; $I^2 = 0\%$; [Analysis 1.15](#)); however, the effect in the diet and exercise counselling group non-significantly favoured the intervention (RR 0.87, 95% CI 0.74 to 1.02; participants = 2777; studies = 6; $I^2 = 0\%$).

Quality of the evidence

We graded the quality of this evidence as high.

1.16 Mean birthweight (g)

There was no statistically significant difference in mean birthweight between intervention and control groups (average MD 12.20, 95% CI -15.26 to 39.65; participants = 8350; studies = 29; $I^2 = 44\%$; [Analysis 1.16](#)).

Sensitivity analysis and investigation of heterogeneity

There were many risk of bias concerns for this outcome (e.g. due to post-randomisation exclusions of women with preterm birth in several studies) but the overall result remained fairly robust to exclusion of high-risk studies.

Quality of the evidence

We graded the quality of the evidence as moderate due to inconsistency.

1.17 and 1.18 Infant birthweight less 2500 g or less than 10th centile

There was no statistically significant difference between groups with respect to birthweight less than 2500 g (average RR 0.88, 95% CI 0.67 to 1.14; participants = 4834; studies = 12; $I^2 = 0\%$; [Analysis 1.17](#)) or small-for-gestational-age infants (average (RR 1.09, 95% CI 0.61 to 1.94; participants = 662; studies = seven; $I^2 = 0\%$; [Analysis 1.18](#)).

Quality of the evidence

We downgraded the quality of this evidence to moderate due to potential risk of bias concerns relating mainly to the limited reporting of this outcome.

1.19 Shoulder dystocia

There was no statistically significant difference in the risk of shoulder dystocia between intervention and control groups (average RR 1.02, 95% CI 0.57 to 1.83; participants = 3253; studies = four; $I^2 = 8\%$; [Analysis 1.19](#)).

Quality of the evidence

We graded this evidence as moderate quality due to imprecision.

1.20 Neonatal hypoglycaemia

There was no statistically significant difference in the risk of neonatal hypoglycaemia between intervention and control groups (average RR 0.95, 95% CI 0.76 to 1.18; participants = 2601; studies = four; $I^2 = 0\%$; [Analysis 1.20](#)).

Quality of the evidence

We graded this evidence as moderate quality due to indirectness (may not apply to all types of interventions).

1.21 Neonatal birth trauma

There was no statistically significant difference between intervention and control groups (average RR 0.89, 95% CI 0.35 to 2.30; participants = 2256; studies = two; $I^2 = 0\%$; [Analysis 1.21](#)). Both included studies ([Dodd 2014](#); [Vesco 2013](#)) were diet and exercise counselling interventions and were conducted in high-risk populations.

Quality of the evidence

We graded this evidence as moderate quality due to imprecision.

1.22 Neonatal hyperbilirubinaemia

There was no statistically significant difference between intervention and control groups (average RR 0.83, 95% CI 0.62 to 1.10; participants = 2256; studies = two; $I^2 = 0\%$; [Analysis 1.22](#)). Both included studies ([Dodd 2014](#); [Vesco 2013](#)) were diet and exercise counselling interventions and were conducted in high-risk populations.

Quality of the evidence

We graded this evidence as moderate quality due to indirectness (may not apply to all types of interventions).

1.23 Neonatal respiratory distress syndrome

Infants in the intervention group had a significantly reduced risk of experiencing respiratory distress than infants in the control group (average RR 0.47, 95% CI 0.26 to 0.85; participants = 2256; studies = two; $I^2 = 0\%$; [Analysis 1.23](#)). Both included studies ([Dodd 2014](#); [Vesco 2013](#)) were diet and exercise counselling interventions and were conducted in high-risk populations.

Quality of the evidence

We graded this evidence as moderate quality due to indirectness (may not apply to all types of interventions).

1.24 Postpartum haemorrhage

There was no difference in this outcome between intervention and control groups (average RR 0.94, 95% CI 0.78 to 1.14; participants = 2901; studies = two; $I^2 = 0\%$; [Analysis 1.24](#)).

Quality of the evidence

We graded this evidence as high quality.

2. Diet interventions (low glycaemic load (GL) diet) versus routine care

A maximum of five studies contributed data to this comparison ([Clapp 2002a](#); [Louie 2011](#); [Moses 2014](#); [Rhodes 2010](#); [ROLO 2012](#)).

1. *Excessive GWG*: Low GL dietary interventions significantly reduced the risk of excessive GWG in the intervention group compared with the control group (RR 0.74, 95% CI 0.55 to 0.99; participants = 833; studies = two; $I^2 = 46\%$; [Analysis 2.1](#)). The test for subgroup differences was not significant ($\text{Chi}^2 = 1.30$, $\text{df} = 1$ ($P = 0.25$), $I^2 = 22.9\%$).
2. *Mean GWG*: Due to substantial heterogeneity, we did not pool these data.
3. *Low GWG*: Only one study contributed data ([Louie 2011](#)) and found no statistically significant difference between intervention and control arms ([Analysis 2.3](#)).
4. *Preterm birth*: One study contributed data to two subgroups in this analysis. There was no statistically significant difference between intervention and control groups (average RR 0.33, 95% CI 0.11 to 1.02; participants = 804; studies = two; $I^2 = 0\%$; [Analysis 2.4](#); Test for subgroup differences: $\text{Chi}^2 = 0.21$, $\text{df} = 1$ ($P = 0.65$), $I^2 = 0\%$).
5. *Caesarean delivery*: Two studies contributed data to the high-risk subgroup. There was no statistically significant difference between the intervention and control groups (average RR 0.99, 95% CI 0.33 to 3.01; participants = 133; studies = two; $I^2 = 65\%$; [Analysis 2.5](#)).

6. *Infant birthweight greater than 4000 g*: There was no statistically significant difference between the intervention and control groups (average RR 0.96, 95% CI 0.77 to 1.20; participants = 1472; studies = four; $I^2 = 14\%$; [Analysis 2.6](#); however, the test for subgroup differences suggested that subgroup results may differ in respect to this outcome, with more macrosomia babies born to high-risk women in the intervention group ($\text{Chi}^2 = 2.12$, $\text{df} = 1$ ($P = 0.15$), $I^2 = 52.9\%$).
7. *Pre-eclampsia*: no data available.

We graded the evidence relating to excessive GWG as moderate quality, and for the other outcomes analysed as low quality due to heterogeneity or imprecision and sparse data, therefore it is likely that further research may change these effect estimates.

3. Diet and exercise counselling versus routine care

A maximum of 13 studies contributed data to these meta-analyses. To avoid duplication of data from [Althuisen 2013](#) we did not combine subgroup data.

- Excessive GWG*: Interventions reduced the incidence of excessive GWG in low-risk participants (average RR 0.72, 95% CI 0.55 to 0.95; participants = 247; studies = 2; $I^2 = 0\%$) and there was a trend towards a reduction in excessive GWG in the high-risk subgroup (RR 0.85, 95% CI 0.71 to 1.02; participants = 2725; studies = nine; $I^2 = 69\%$; [Analysis 3.1](#); Test for subgroup differences: $\text{Chi}^2 = 3.51$, $\text{df} = 2$ ($P = 0.17$), $I^2 = 43.0\%$). We downgraded this evidence to moderate due to heterogeneity.
- Mean GWG*: Mean GWG in kg was reduced with the intervention for the mixed-risk subgroup (MD -1.80, 95% CI -3.36 to -0.24; participants = 444; studies = three; $I^2 = 76\%$) and the high-risk subgroup (MD -0.71, 95% CI -1.34 to -0.08; participants = 2741; studies = 11; $I^2 = 57\%$) but heterogeneity was high ([Analysis 3.2](#)). In the latter, this could be explained by the timing of the measurements, and when two studies that measured weight gain at less than 34 weeks were excluded, data were homogeneous and favoured no clear difference between the intervention and control groups (MD -0.15, 95% CI -0.44 to 0.15; participants = 2424; studies = nine; $I^2 = 0\%$; Test for subgroup differences suggested a difference in effect between subgroups: $\text{Chi}^2 = 5.44$, $\text{df} = 2$ ($P = 0.07$), $I^2 = 63.2\%$).
- Low GWG*: There was no significant difference in low GWG on average overall (RR 1.23, 95% CI 0.89 to 1.72; participants = 2552; studies = five; $I^2 = 49\%$; [Analysis 3.3](#); Test for subgroup differences: $\text{Chi}^2 = 0.07$, $\text{df} = 1$ ($P = 0.79$), $I^2 = 0\%$) or for subgroups; however the overall trend favoured the control group.
- Preterm birth*: There was no significant difference in preterm birth on average overall (RR 0.94, 95% CI 0.57 to 1.55; participants = 3170; studies = seven; $I^2 = 52\%$; [Analysis 3.4](#)) or for subgroups; Test for subgroup differences: $\text{Chi}^2 = 0.32$, $\text{df} = 1$ ($P = 0.57$), $I^2 = 0\%$). We downgraded this evidence to low due to imprecision and heterogeneity.
- Pre-eclampsia*: There was no significant difference in pre-eclampsia on average between intervention and control groups for the high-risk population (average RR 1.06, 95% CI 0.79 to 1.43; participants = 2896; studies = seven; $I^2 = 0\%$; [Analysis 3.5](#)). Only one study contributed events to the low-risk subgroup.
- Caesarean delivery*: Interventions reduced the incidence of caesarean section on average (RR 0.89, 95% CI 0.80 to 1.00; participants = 3406; studies = nine; $I^2 = 3\%$; [Analysis 3.6](#); $P = 0.05$; borderline statistical significance). This trend was consistent

across risk subgroups; Test for subgroup differences: $\text{Chi}^2 = 1.53$, $\text{df} = 2$ ($P = 0.46$), $I^2 = 0\%$.

- Infant birthweight greater than 4000 g*: There was no statistically significant difference in macrosomia on average between intervention and control groups overall (RR 0.92, 95% CI 0.77 to 1.11; participants = 3705; studies = 10; $I^2 = 7\%$; [Analysis 3.7](#)) or for the low-risk or mixed-risk subgroups. However, in the high-risk subgroup an effect in favour of a reduction in macrosomia was of borderline statistical significance (average RR 0.85, 95% CI 0.73 to 1.00; participants = 3252; studies = nine; $I^2 = 0\%$; $P = 0.05$) and the test for subgroup differences was statistically significant ($\text{Chi}^2 = 3.86$, $\text{df} = 1$ ($P = 0.05$), $I^2 = 74.1\%$).

We graded the evidence for diet and exercise counselling interventions as moderate quality, except for the outcome preterm birth which we graded as low quality.

4. Exercise interventions versus routine care

A maximum of 13 studies contributed data to these analyses. Three studies ([Kong 2014](#); [Renault 2014](#); [Ronnberg 2014](#)) involved unsupervised (as opposed to supervised) exercise interventions and we performed sensitivity analyses to determine whether including unsupervised exercise intervention studies had an impact on the results. To avoid duplication of data, where individual studies contributed data to both risk subgroups ([Ronnberg 2014](#); [Ruiz 2013](#)), we did not combine subgroup data.

- Excessive GWG*: Exercise interventions significantly reduced this outcome consistently across risk subgroups with point estimates for low, mixed and high risk subgroups of 0.69, 0.77, and 0.84 respectively ([Analysis 4.1](#)). Test for subgroup differences were not significant: $\text{Chi}^2 = 1.36$, $\text{df} = 2$ ($P = 0.51$), $I^2 = 0\%$.
- Mean GWG*: When one study at a high risk of bias ([Price 2012](#)) was excluded from the mixed-risk subgroup, the intervention was associated with a statistically significant reduction in mean weight gain in kg compared with the control in the mixed-risk subgroup (MD -1.35, 95% CI -1.80 to -0.89; participants = 1134; studies = three; $I^2 = 0\%$), and low risk subgroup (one study only), but not the high-risk subgroup (MD -0.32, 95% CI -1.15 to 0.50; participants = 476; studies = four; $I^2 = 0\%$); [Analysis 4.2](#). Test for subgroup differences suggested a difference in effect between subgroups: $\text{Chi}^2 = 5.78$, $\text{df} = 2$ ($P = 0.06$), $I^2 = 65.4\%$.
- Low GWG*: There was an increase in low GWG of borderline statistical significance between intervention and control groups for the mixed risk subgroup (average RR 1.20, 95% CI 1.00 to 1.43; participants = 1336; studies = two; $I^2 = 0\%$; $P = 0.05$) and low risk subgroup (one study only) but not the high-risk subgroup (average RR 1.03, 95% CI 0.66 to 1.60; participants = 504; studies = three; $I^2 = 0\%$; [Analysis 4.3](#)). Test for subgroup differences were not significant: $\text{Chi}^2 = 0.98$, $\text{df} = 2$ ($P = 0.61$), $I^2 = 0\%$.
- Preterm birth*: There was no statistically significant difference in preterm birth on average between intervention and control groups for the low risk (one study only), mixed risk (average RR 1.92, 95% CI 0.75 to 4.93; participants = 1129; studies = three; $I^2 = 0\%$) or the high-risk subgroup (average RR 1.34, 95% CI 0.51 to 3.55; participants = 504; studies = three; $I^2 = 0\%$; [Analysis 4.4](#)); however the trend consistently favoured the control group. The test for subgroup differences was not significant: $\text{Chi}^2 = 0.27$, $\text{df} = 1$ ($P = 0.60$), $I^2 = 0\%$.
- Pre-eclampsia*: There was no statistically significant difference in pre-eclampsia overall between intervention and control groups

- (average RR 0.99, 95% CI 0.58 to 1.66; participants = 1253; studies = four; $I^2 = 0\%$; [Analysis 4.5](#)) and subgroup findings were similar: Test for subgroup differences: $\text{Chi}^2 = 0.51$, $\text{df} = 1$ ($P = 0.48$), $I^2 = 0\%$.
- Caesarean delivery:** There was no statistically significant difference in caesarean delivery between intervention and control groups for low risk (one study only), mixed risk (average RR 0.96, 95% CI 0.76 to 1.22; participants = 2263; studies = six; $I^2 = 24\%$) or the high-risk subgroup (average RR 0.98, 95% CI 0.81 to 1.20; participants = 645; studies = five; $I^2 = 0\%$; [Analysis 4.6](#)); . Test for subgroup differences: $\text{Chi}^2 = 0.37$, $\text{df} = 2$ ($P = 0.83$), $I^2 = 0\%$.
 - Infant birthweight greater than 4000 g:** There was no statistically significant difference in macrosomia between intervention and control groups for the low-risk (one study only), mixed-risk (average RR 0.81, 95% CI 0.64 to 1.02; participants = 2445; studies = seven; $I^2 = 0\%$) or the high-risk subgroups (RR 0.65, 95% CI 0.22 to 1.91; participants = 504; studies = three; $I^2 = 74\%$; [Analysis 4.7](#) Test for subgroup differences: $\text{Chi}^2 = 0.14$, $\text{df} = 1$ ($P = 0.71$), $I^2 = 0\%$. However, the trend across subgroups consistently favoured the intervention, and the effect for the mixed-risk subgroup was of borderline statistical significance. ($P = 0.07$) Furthermore, when three studies with risk of bias concerns were excluded ([Cordero 2014](#); [Murtezani 2014](#); [Stafne 2012](#)), the RR for the mixed-risk population clearly favoured the intervention group (average RR 0.56, 95% CI 0.36 to 0.88; participants = 1274; studies = eight; $I^2 = 0\%$).

As the number of studies included in most analyses were few, we did not assess funnel plots. Including studies of unsupervised exercise did not have a significant impact on the results. We graded this evidence as moderate quality overall, except for the evidence on preterm birth (low quality) which was very imprecise and potentially subject to a serious risk of attrition and/or reporting bias.

5. Diet and supervised exercise interventions versus routine care

A maximum of five studies contributed data to these analyses; two studies contributed data to each of the mixed- and high-risk subgroups, one study ([Hui 2014](#)) reported results separately for both subgroups, therefore we were able to pool these data.

- Excessive GWG:** Combined exercise and diet interventions significantly reduced excessive weight gain (average RR 0.75, 95% CI 0.61 to 0.92; participants = 689; studies = five; $I^2 = 18\%$, [Analysis 5.1](#); When one study at high risk of bias was excluded ([Ruchat 2012](#)), the test for subgroup differences suggested that there might be a difference in effect according to risk, with a smaller effect in the high-risk subgroup: Test for subgroup differences: $\text{Chi}^2 = 4.54$, $\text{df} = 2$ ($P = 0.10$), $I^2 = 55.9\%$.
- Mean GWG:** The interventions reduced mean GWG compared with controls (average MD -1.31, 95% CI -3.00 to 0.37; participants = 348; studies = three; $I^2 = 43\%$; borderline significance, [Analysis 5.2](#)). However, the test for subgroup differences suggested that there might be a difference in effect according to risk, with a smaller effect in the high-risk subgroup :Test for subgroup differences: $\text{Chi}^2 = 4.90$, $\text{df} = 2$ ($P = 0.09$), $I^2 = 59.2\%$.
- Low GWG:** Only one study showing no difference contributed data to this outcome ([Analysis 5.3](#)).
- Preterm birth:** No data available

- Pre-eclampsia:** Only one study showing no difference contributed data to this outcome ([Analysis 5.4](#)).
- Caesarean delivery:** There was no statistically significant difference in the risk of caesarean delivery between intervention and control groups (average RR 1.00, 95% CI 0.69 to 1.45; participants = 607; studies = three; $I^2 = 0\%$; [Analysis 5.5](#); Test for subgroup differences: $\text{Chi}^2 = 0.29$, $\text{df} = 1$ ($P = 0.59$), $I^2 = 0\%$.
- Infant birthweight greater than 4000 g:** There was no statistically significant difference between groups for this outcome (RR 1.02, 95% CI 0.71 to 1.46; participants = 398; studies = three; $I^2 = 0\%$; [Analysis 5.6](#); Test for subgroup differences: $\text{Chi}^2 = 0.33$, $\text{df} = 1$ ($P = 0.56$), $I^2 = 0\%$.

We graded this evidence from analyses as low-to-moderate quality due to imprecision (sparse data) and some inconsistencies.

6. Diet counselling only versus routine care

A maximum of seven heterogeneous studies contributed data to these analyses ([Di Carlo 2014](#); [Jeffries 2009](#); [Laitinen 2009](#); [Quinlivan 2011](#); [Rae 2000](#); [Thornton 2009](#); [Wolff 2008](#)).

- Excessive GWG:** We did not combine subgroup data for this analysis as one study contributed data to both subgroups. There was no statistically significant difference between intervention and control arms ([Analysis 6.1](#)). The test for subgroup differences showed that subgroup results were similar: $\text{Chi}^2 = 0.49$, $\text{df} = 1$ ($P = 0.48$), $I^2 = 0\%$.
- Mean GWG:** Data for this outcome were very heterogeneous (I^2 greater than 90%) with four out of seven studies finding a difference in mean GWG of greater than 4 kg, with the other three studies finding little difference; therefore, we did not combine these data ([Analysis 6.2](#)).
- Low GWG:** Only one study contributed data ([Laitinen 2009](#)), which found that significantly more women in the intervention arm had low GWG compared with the control arm ([Analysis 6.3](#)).
- Preterm birth:** There was no statistically significant difference in the risk of preterm birth between intervention and control groups (average RR 0.67, 95% CI 0.26 to 1.73; participants = 591; studies = three; $I^2 = 0\%$, [Analysis 6.4](#)); Test for subgroup differences: $\text{Chi}^2 = 0.00$, $\text{df} = 1$ ($P = 0.99$), $I^2 = 0\%$.
- Pre-eclampsia:** There was no statistically significant difference in the risk of pre-eclampsia between intervention and control groups (RR 0.90, 95% CI 0.54 to 1.48; participants = 634; studies = four; $I^2 = 0\%$; [Analysis 6.5](#); Test for subgroup differences: $\text{Chi}^2 = 2.05$, $\text{df} = 1$ ($P = 0.15$), $I^2 = 51.2\%$.
- Caesarean section:** There was no statistically significant difference in the risk of caesarean delivery between intervention and control groups (average RR 1.06, 95% CI 0.93 to 1.21; participants = 754; studies = five $I^2 = 2\%$; [Analysis 6.6](#); Test for subgroup differences: $\text{Chi}^2 = 0.30$, $\text{df} = 1$ ($P = 0.59$), $I^2 = 0\%$).
- Infant birthweight greater than 4000 g:** There was no statistically significant difference in the risk of macrosomia between intervention and control groups when data from two studies conducted in high-risk women were pooled (RR 1.81, 95% CI 0.88 to 3.72; participants = 349; studies = two; $I^2 = 0\%$, [Analysis 6.7](#)).

We graded the evidence relating to these interventions as low quality overall due to heterogeneity and risk of bias concerns. As the number of studies included in most analyses were few, we did not assess funnel plots.

DISCUSSION

Summary of main results

This updated review included 65 randomised controlled trials (RCTs) in total with 49 RCTs involving at least 11,444 participants contributing data to quantitative synthesis. Twenty RCTs were considered to be at moderate-to-high risk of bias. Where these studies contributed data (14 studies), we performed sensitivity analysis to determine how including these data impacted on the results. Diet interventions most commonly involved a low GL, diabetic, calorie-controlled or low fat diet; exercise interventions were most commonly of moderate intensity involving walking, dance, or aerobic classes. Most included studies were conducted in developed countries. Overall findings are summarised in [Summary of findings for the main comparison](#). Diet or exercise, or both, interventions reduced the risk of excessive gestational weight gain (GWG) by an average of 20% (95% CI, 13 to 27%) overall. Data were moderately heterogeneous; however this overall effect was robust to sensitivity analysis and consistent across the different types of interventions, therefore we graded this evidence as high quality. The greatest effect on excessive GWG was noted for combined diet plus supervised exercise interventions.

Data for mean GWG were too heterogeneous to pool and were inconsistent between, and frequently within, the different types of intervention groups, therefore, we did not pool these data. However, for subgroup analyses according to the risk of weight-related complications, we pooled data if heterogeneity was mild or moderate, and downgraded the evidence accordingly. Limited evidence from diet and exercise counselling interventions, exercise only interventions, and diet and supervised exercise interventions suggested that there might be a difference in effect on mean weight gain according to risk, with a smaller effect in the high-risk subgroups (*low quality evidence*).

Women receiving diet or exercise, or both interventions were more likely to experience low GWG than controls (average risk ratio (RR) 1.14, 95% confidence interval (CI) 1.02 to 1.27; participants = 4422; studies = 11; $I^2 = 3$; *moderate-quality evidence*). We found no difference between intervention and control groups with regard to pre-eclampsia (RR 0.95, 95% CI 0.77 to 1.16; participants = 5330; studies = 15; $I^2 = 0$; *high-quality evidence*); however, maternal hypertension (not a pre-specified outcome) was reduced in the intervention group compared with the control group overall (average RR 0.70, 95% CI 0.51 to 0.96; participants = 5162; studies = 11; $I^2 = 43$; *low-quality evidence*).

There was no clear difference between groups with regard to caesarean delivery overall (RR 0.95, 95% CI 0.88 to 1.03; participants = 7534; studies = 28; $I^2 = 9$; *high-quality evidence*); although the effect estimate suggested a small difference (5%) in favour of the interventions. In addition, for combined diet and exercise counselling interventions there was a 13% (-1% to 25%) reduction in this outcome (borderline statistical significance).

We found no difference between groups with regard to preterm birth overall (average RR 0.91, 95% CI 0.68 to 1.22; participants = 5923; studies = 16; $I^2 = 16$; *moderate-quality evidence*); however limited evidence suggested that these effect estimates may differ according to the types of interventions, with a trend towards an increased risk for exercise-only interventions.

We found no clear difference between intervention and control groups with regard to infant macrosomia overall (average RR 0.93, 95% CI 0.86 to 1.02; participants = 8598; studies = 27; $I^2 = 0$; *high-quality evidence*), although the effect estimate suggested a small difference (7% reduction) in favour of the intervention group. The largest effect size occurred in the supervised exercise-only intervention group (RR 0.81, 95% CI 0.64 to 1.02; participants = 2445; studies = seven; $I^2 = 0$), which approached statistical significance ($P = 0.07$). Furthermore, in subgroup analysis by risk, high-risk women receiving combined diet and exercise counselling interventions experienced a 15% reduced risk of infant macrosomia (average RR 0.85, 95% CI 0.73 to 1.00; participants = 3252; studies = nine; $I^2 = 0$; $P = 0.05$; *moderate-quality evidence*).

There were no differences in the risk of poor neonatal outcomes including shoulder dystocia, neonatal hypoglycaemia, hyperbilirubinaemia, or birth trauma (all *moderate-quality evidence*) between intervention and control groups; however, infants of high-risk women had a reduced risk of respiratory distress syndrome if their mothers were in the intervention group (RR 0.47, 95% CI 0.26 to 0.85; participants = 2256; studies = two; $I^2 = 0$; *moderate-quality evidence*).

The effect on behaviour modification outcomes, i.e. dietary and physical activity outcomes, in general, favoured the intervention groups; however, these outcomes were at high risk of bias and mainly reflected whether the implementation of the interventions was successful. Low-quality evidence suggested that the beneficial effects of interventions on weight control during pregnancy may be sustained postpartum. For certain outcomes, e.g. childhood weight, we found no data for meta-analysis.

For a brief summary of the effects of the different types of interventions on the main outcomes, see [Summary of findings 2](#).

Overall completeness and applicability of evidence

There is a growing body of evidence to support the use of diet or exercise, or both, interventions to reduce excessive GWG in pregnancy. We found high-quality evidence of other related health benefits for women and newborns, applicable to most pregnant women who are otherwise healthy, irrespective of their prepregnancy weight. Exercise appears to be an important component of weight reduction interventions; however the evidence with regard to the effect of exercise on the risk of preterm birth is of a moderate quality and this outcome should be rigorously evaluated in future studies to enable the establishment of appropriate guidelines. The evidence is not applicable to women with specific contraindications to exercise in pregnancy or pre-existing medical conditions. Although we included four studies conducted in women with gestational diabetes, data were sparse and it is not clear whether the review findings apply to women with this condition. More research (qualitative and quantitative) to improve outcomes in this high risk group is needed.

Most included studies were carried out in developed countries and it is not clear whether these results are widely applicable to lower income settings with fewer human and financial resources. More research is needed in these less developed settings, where obesity is increasingly a major health issue. Innovative interventions utilising mobile-phone technology (e.g. [Pollak 2014](#)) are of interest and further developments in this area are anticipated.

Quality of the evidence

Using the GRADE approach, we considered the quality of the evidence relating to excessive GWG as high quality. Although moderate heterogeneity was present, we upgraded our assessment of evidence quality from moderate-to-high quality as findings were precise and robust to sensitivity analysis. We graded the evidence with regard to the risk of low GWG as high quality as these estimates were consistent and precise across included studies. We downgraded the evidence with regard to preterm birth (no statistically significant difference) to moderate due to risk of bias concerns from attrition and under-reporting. We graded the quality of the evidence for pre-eclampsia, caesarean delivery and macrosomia as high quality and most other outcomes, as moderate quality.

We downgraded some evidence due to heterogeneity. Many factors might have contributed to this heterogeneity including obvious and subtle differences in the types of interventions, types of participants (e.g. BMIs, parity, age), delivery of the intervention (e.g. whether the intervention was incorporated into antenatal visits or delivered separately by a dietician), timing of the measurements (e.g. weight gain assessed at 34 versus 38 weeks), timing of commencement of the intervention (e.g. first, second or third trimester), sample sizes, etc. An in-depth evaluation of individual interventions was beyond the scope of this review; however, our impression was that the more intensely monitored/supervised the intervention, the better the study results.

Potential biases in the review process

We took a number of steps to minimise bias in the review process by including all relevant RCTs, with two review authors independently classifying them, extracting data, and resolving disagreements by discussion with the other authors. Where expected outcome data were missing we made an effort to contact the study investigators, and we included adjusted data from cluster-RCTs where possible. In the previous version of this review we included two quasi-RCTs (Bechtel-Blackwell 2002; Moses 2006), which we excluded for this update after deciding to limit the review to RCTs. Due to issues of scope and relevance, we also excluded two early studies of appetite suppressant drugs that had been included in the original review (Boileau 1968; Silverman 1971).

We considered it clinically meaningful to produce overall estimates of average effects across all studies where possible, organised by the type of intervention, using random effects methods. Interventions were often multifaceted and were quite heterogeneous in approach, for example, in the timing, duration, intensity, content and delivery. Some studies evaluated more than one type of intervention. Dodd 2014, for example, was mainly a diet and exercise counselling intervention study and we included it as such; however, 26% of participants in the intervention arm underwent a supervised walking exercise as part of a nested RCT. Where possible, when heterogeneity existed between studies evaluating apparently similar interventions, which could not be explained by our 'Risk of bias' assessment, we attempted to identify the possible reasons for it. In addition, although we made distinctions between types of diet and exercise interventions according to whether the exercise component was supervised or not, the results were robust on exploratory analyses when all combined diet and exercise intervention data for the main outcomes were pooled.

Two studies compared higher impact interventions with lower impact interventions (Ruchat 2012; Thornton 2009), and several studies of low GL diets compared the intervention with an alternative (low-fat, moderate/high GL or conventional healthy eating) diet (Rhodes 2010; Louie 2011; Moses 2009; Moses 2014). For these studies, we pooled the data of the alternative intervention with the control group which, in most other studies, comprised routine care. This may have contributed to heterogeneity in the meta-analyses and might have led to an underestimation of the summary effect of the intervention. Clapp 2002b compared different exercise intensities at different stages of pregnancy (before versus after 20 weeks' gestation) and found that low-intensity exercise in early pregnancy moving on to higher-intensity exercise after 20 weeks was associated with a lower pregnancy weight gain than either high- followed by low-intensity exercise or moderate-intensity exercise throughout. We did not explore the impact of higher- versus lower-intensity interventions, which may have provided important information for exercise interventions and certain outcomes, such as preterm birth. This was largely due to a sparseness of data and time constraints.

Several studies reported maternal 'hypertension', and not pre-eclampsia, and we extracted and analysed these data. This was not prespecified in the protocol (see [Differences between protocol and review](#)); however, we made every effort to minimise bias in this process, and consider the pooled findings to be of value, albeit low-quality evidence. The effect estimates for hypertension differed from those for pre-eclampsia with a consistent trend towards a reduction in hypertension, but not pre-eclampsia, in intervention arms.

We did not perform meta-analyses according to BMI classification of degree of obesity, although several studies stratified results by BMI (overweight or obese or morbidly obese). In one study that reported these BMI categories separately (Kong 2014), we combined these data for use in our meta-analysis. For studies of high-risk women that reported combined and separate results for overweight and obese categories (Harrison 2013; Petrella 2013; Nascimento 2012), we extracted all data but used the combined data only in our meta-analyses. It is possible that certain types of interventions may be more effective for different high-risk BMI categories and we may try to address this in future versions of this review.

Behaviour modification outcomes may have been subject to potential reviewer bias. Multiple and varied behaviour modification outcomes were reported by the various investigators and we pre-specified only three outcomes (energy intake, fibre intake and a physical activity measure) for inclusion in the review. In addition, numerous different scales and time points were reported by study investigators, a narrative discussion of which is beyond the scope of this review. However, in many respects, behaviour outcome measures are measures of the intervention rather than the effect of the intervention and we consider this outcome to be a poor (indirect) measure of effectiveness of an intervention. In addition, these outcomes were subject to other serious risk of bias concerns, including detection (often self-reported) and attrition bias.

Agreements and disagreements with other studies or reviews

A 2012 UK Health Technology Assessment review (Thangaratnam 2012) included 30 RCTs in a meta-analysis of GWG and reported an overall reduction (± 1 kg) in mean GWG in the intervention group

compared with controls. Two other systematic reviews (Ronnberg 2010; Skouteris 2010) that included RCTs and non-randomised studies also reported GWG outcomes in favour of the interventions. Thangaratinam 2012 reported that the largest weight reduction occurred with dietary interventions (a mean reduction of 3.36 kg), which were also effective at reducing gestational hypertension, pre-eclampsia, preterm birth and shoulder dystocia. Due to substantial heterogeneity, we did not pool mean weight gain data and our review does not agree with these findings. Thangaratinam 2012 utilised data from non-randomised studies to provide evidence on adverse effects; however, most of these data were derived from studies on extreme diet and famine and therefore have limited applicability. Randomised controlled trial data on adverse effects remain sparse and we were unable to provide additional evidence in this regard.

We were unable to show a reduced risk of macrosomia overall, as was shown in Thangaratinam 2012, although our findings did not exclude a small reduction in risk. In addition, our findings suggested greater reductions may be achieved for high-risk women who received combined diet and exercise interventions, and women receiving supervised exercise-only interventions. Dodd 2014, the largest study included in this review additionally reported the rate of very high birthweight babies (greater than 4500 g), finding a significant reduction in this outcome in the intervention arm; however, we did not include this outcome.

We found limited evidence that certain interventions were somewhat less effective in reducing GWG in high-risk women compared with the lower-risk group. To our knowledge this has not been previously shown and requires further investigation. Several of our included studies reported gestational diabetes as an outcome and exploratory analysis suggested that the effect of diet and exercise interventions on this outcome might be significant. We did not modify our protocol to include this important outcome as a separate Cochrane review on the topic is in progress (Crane 2013).

AUTHORS' CONCLUSIONS

Implications for practice

High-quality evidence indicates that diet or exercise, or both, during pregnancy can reduce the risk of excessive gestational weight gain (GWG). Other benefits may include a lower risk of caesarean delivery, macrosomia, and neonatal respiratory morbidity, particularly for high-risk women receiving combined diet and exercise interventions. Moderate-intensity exercise appears to be an important part of controlling weight gain in pregnancy, however the evidence on the risk of preterm birth is

limited and more research is needed to establish safe guidelines. Most included studies were carried out in developed countries and it is not clear whether these results are widely applicable to lower income settings.

Implications for research

The effectiveness of these interventions in low-income countries and in women with non-Western lifestyles needs further evaluation. In addition, further research is needed, particularly in high-risk women to determine whether other types of diet or adjuvant interventions (e.g. probiotics, metformin), are of value in reducing excessive GWG and improving maternal and infant outcomes. The evidence with regard to the effect of antenatal exercise on the risk of preterm birth is incomplete and this outcome should be carefully monitored and reported by researchers to enable the establishment of appropriate guidelines. Studies of interventions utilising mobile-phone technology are of interest and further developments in this area are anticipated. Research to investigate strategies to implement diet and exercise programs into routine antenatal care in different settings is needed.

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* Indicates the major publication for the study

CHARACTERISTICS OF STUDIES

Characteristics of included studies [ordered by study ID]

Althuisen 2013

Methods	RCT, 8 midwifery practices in The Netherlands from February 2005 to May 2006.
Participants	246 randomised, 219 analysed. Inclusion criteria: women expecting their first child, able to read and speak Dutch, and in the first 14 weeks of gestation. Exclusion criteria: miscarriage, gestation \geq 15 weeks.
Interventions	Intervention group: counselling (5 x approximately 15 minute sessions on weight, physical activity and diet) (n = 106). Interventions were face-to-face at 18, 22, 30, and 36 weeks' gestation, with a telephone session at 8 weeks postpartum. Control group: routine care (no counselling) (n = 113).
Outcomes	Primary outcomes were excessive weight gain, BMI, postpartum weight retention, birthweight, macrosomia, preterm birth, gestational diabetes.
Notes	Age (intervention, control): $29.2 \pm 3.3/30.4 \pm 4$. Enrolment gestational age < 14 weeks. Prepregnancy BMI: $24 \pm 4.2/23.5 \pm 3.8$. Authors concluded that "The lifestyle counselling intervention evaluated in this study did not have an effect on excessive weight gain or postpartum weight retention. Our findings for overweight and obese women need to be confirmed in a larger, randomised trial".

Risk of bias

Diet or exercise, or both, for preventing excessive weight gain in pregnancy (Review)

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Althuisen 2013 (Continued)

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	"A computerised random number generator drew up an allocation schedule pre-stratified for midwifery practices."
Allocation concealment (selection bias)	Unclear risk	Not described.
Blinding of participants and personnel (performance bias) All outcomes	High risk	Blinding not possible for the intervention.
Blinding of outcome assessment (detection bias) All outcomes	Unclear risk	Research assistants blinded to treatment allocation.
Incomplete outcome data (attrition bias) All outcomes	Unclear risk	11% of participants (17 in intervention and 10 in control group) dropped out during the course of the study.
Selective reporting (reporting bias)	Unclear risk	All expected outcomes reported.
Other bias	Low risk	None noted. Baseline characteristics comparable.

Angel 2011

Methods	RCT conducted at San Francisco General Hospital, USA between 2006 and 2009 (abstract only).	
Participants	64 randomised. Inclusion criteria: obese/overweight, ages 18-42 years, from 20 weeks. Exclusion criteria: NR.	
Interventions	Intervention group: low glycaemic load diet. Control group: low fat diet.	
Outcomes	Excessive weight gain, excessive fat gain.	
Notes	Age (intervention, control): NR. Enrolment gestational age approx. 20 weeks. Prepregnancy BMI: NR. Abstract only with no usable data. "This evidence suggests that dietary patterns are important for achieving weight gain recommendations among overweight and obese pregnant women."	

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	"randomly assigned."

Angel 2011 (Continued)

Allocation concealment (selection bias)	Unclear risk	Not described.
Blinding of participants and personnel (performance bias) All outcomes	Unclear risk	Not described.
Blinding of outcome assessment (detection bias) All outcomes	Unclear risk	Not described.
Incomplete outcome data (attrition bias) All outcomes	Unclear risk	14% drop out. Not yet reported in full.
Selective reporting (reporting bias)	Unclear risk	Abstract only with little data.
Other bias	Unclear risk	Abstract only with little data.

Asbee 2009

Methods	RCT, set in resident obstetric clinic in Charlotte, North Carolina, USA.
Participants	<p>Inclusion criteria: prenatal care established at 6-16 weeks of gestation, age 18-49 years, all prenatal care received at the Resident Obstetrics Clinic, English-speaking, Spanish-speaking, or both, and singleton pregnancy.</p> <p>Exclusion criteria: BMI higher than 40, pre-existing diabetes, untreated thyroid disease, or hypertension requiring medication or other medical conditions that might affect body weight, delivery at institution other than Carolinas Medical Center Main, pregnancy ending in premature delivery (less than 37 weeks), and limited prenatal care (fewer than 4 visits).</p>
Interventions	<p>Intervention group (n = 57) received consistent program of dietary and lifestyle counselling. At the initial visit, participants met with a registered dietician to receive a standardised counselling session, including information on pregnancy-specific dietary and lifestyle choices. The counselling consisted of recommendations for a patient-focused caloric value divided in a 40% CHO, 30% protein, and 30% fat fashion. Participants were instructed to engage in moderate-intensity exercise at least 3 times per week and preferably 5 times per week. They also received information on the appropriate weight gain during pregnancy using the IOM guidelines. Each participant met with the dietician only at the time of enrolment. At each routine obstetrical appointment, the healthcare provider informed the participant whether her weight gain was at the appropriate level. If her weight gain was not within the IOM guidelines, the participant's diet and exercise regimen were reviewed and she was advised on increasing or decreasing her intake and increasing or decreasing exercise.</p> <p>Control group (n = 43) received routine prenatal care, including an initial physical examination and history, routine laboratory tests, and routine visits per ACOG standards. The only counselling on diet and exercise during pregnancy was that included in a standard prenatal booklet. The healthcare provider did not counsel the participant regarding any changes in diet or lifestyle.</p>
Outcomes	<p>Weight gain, caesarean delivery, pre-eclampsia, shoulder dystocia.</p> <p>Total weight gain was defined as weight just before delivery minus prepregnancy weight.</p>
Notes	Age (intervention, control): 26.7 ± 6.0, 26.4 ± 5.0.

Asbee 2009 (Continued)

Enrolment gestational age (intervention, control): 13.7 ± 3.6, 13.6 ± 2.2 weeks.

Prepregnancy BMI: 25.5 ± 6.0, 25.6 ± 5.1 kg/m².

BMI category, n (intervention, control):

- underweight and normal weight (BMI < 26): 35, 25;
- overweight (BMI 26-29.0): 10, 8;
- obese (BMI > 29.0): 12, 10.

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Randomisation was performed using computer-generated random allocation.
Allocation concealment (selection bias)	Low risk	Study allocation was concealed in numbered and sealed opaque envelopes.
Blinding of participants and personnel (performance bias) All outcomes	Unclear risk	Not described.
Blinding of outcome assessment (detection bias) All outcomes	Unclear risk	Not described.
Incomplete outcome data (attrition bias) All outcomes	Low risk	No loss to follow-up reported. Trial authors stated that they had carried out an ITT analysis: data were analysed for participants according to their randomly-allocated group; all participants were included in the analysis.
Selective reporting (reporting bias)	Low risk	The outcomes reported as in the published protocol.
Other bias	High risk	Demographic data were similar. Age, prepregnancy weight, height and BMI were not different at baseline. Women with delivery before 37 weeks were excluded.

Barakat 2011

Methods	RCT, set in Hospital de Fuen-labrada, Madrid, Spain.
Participants	80 women randomised. Inclusion criteria: healthy pregnant women (age, 23-38 years), had uncomplicated, singleton pregnancies. Exclusion criteria: any type of absolute obstetric contraindication to aerobic exercise during pregnancy, which included other contraindications that the authors considered to have a relevant influence on maternal perception of health: significant heart disease, restrictive lung disease, incompetent cervix/cerclage, multiple gestation, risk of premature labour, pre-eclampsia/pregnancy-induced hyperten-

Barakat 2011 (Continued)

sion, thrombophlebitis, recent pulmonary embolism (last 5 years), acquired infectious disease, retarded intrauterine development, serious blood disease, and/or absence of prenatal care.

Interventions	<p>Intervention group: (40 randomised) moderate physical activity, included a total of 35- to 45-min weekly sessions 3 days each week from the start of the pregnancy (weeks 6-9) to the end of the 3rd trimester (weeks 38-39), an average of 85 training sessions, exercise intensity was light-to-moderate. Exercise was supervised by a fitness specialist and was in groups of 10-12 women.</p> <p>Control group: (40 randomised) routine care.</p>
Outcomes	Weight gain, caesarean, birthweight < 4000 g, birthweight > 4000 g.
Notes	Authors concluded that a moderate physical activity program that is performed over the first, second, and third trimester of pregnancy improves the maternal perception of health status.

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Randomly assigned by use of a random number table.
Allocation concealment (selection bias)	Unclear risk	Not described.
Blinding of participants and personnel (performance bias) All outcomes	Unclear risk	Not described.
Blinding of outcome assessment (detection bias) All outcomes	Unclear risk	Not described. It is not clear how lack of blinding would impact on the outcomes measured.
Incomplete outcome data (attrition bias) All outcomes	Unclear risk	80 women were randomised and 67 were analysed; 34 in the exercise group, 33 in the control group. Reason of discontinued were similar in both groups.
Selective reporting (reporting bias)	Unclear risk	Assessment from published study report.
Other bias	High risk	No between-group differences regarding most potential confounding variables (such as occupational activities, standing, smoking habits, alcohol intake) but parity was not balanced between groups; the exercise group had a higher percentage of nulliparous women (76.5%) than the control group (36.4%).

Bisson 2014

Methods	RCT conducted at Centre Mere Enfant CHU de Quebec, Laval University, Quebec City, Canada.
Participants	<p>37 randomised, 4 withdrawals. Numbers in each group not stated.</p> <p>Inclusion criteria: obese pregnant women < 15 weeks.</p> <p>Exclusion criteria: NR.</p>

Bisson 2014 (Continued)

Interventions	<p>Intervention group: 12 week supervised moderate exercise program consisting of 3 weekly 1-hr sessions in a hospital-based setting from 15th to 28th week.</p> <p>Control group: routine care.</p>
Outcomes	"perinatal and maternal outcomes."
Notes	<p>Abstract only with no usable data. Exercising women maintained their fitness compared with control women ($P = 0.047$) and "had reduced weekly weight gain (0.3 ± 0.1 kg/wk vs 0.5 ± 0.2 kg/wk for exercise and control, respectively, $p = 0.047$." "3 exercising versus 6 control women developed either gestational diabetes or hypertension." "Based on preliminary data, birth weight and gestational age at delivery were comparable between groups (3587 ± 459 g and $393/7 \pm 11/7$ weeks, vs 3387 ± 409 g and $393/7 \pm 11/7$ weeks in the exercising and control groups respectively, NS."</p> <p>Authors concluded that "An individualized exercise training effective in maintaining maternal fitness and limiting gestational weight gain in obese, pregnant women does not increase prematurity. However larger gestational weight gain in obese, pregnant women does not increase prematurity. However larger interventional study in this population will determine the potential benefits of maternal exercise during pregnancy on child growth, metabolism and development."</p>

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	"randomly assigned."
Allocation concealment (selection bias)	Unclear risk	Not described.
Blinding of participants and personnel (performance bias) All outcomes	Unclear risk	Not described.
Blinding of outcome assessment (detection bias) All outcomes	Unclear risk	Unclear due to limited reporting (abstract only) but 4 dropped out. Numbers in each arm was not stated.
Incomplete outcome data (attrition bias) All outcomes	Unclear risk	Abstract only with sparse data.
Selective reporting (reporting bias)	Unclear risk	Abstract only with sparse data.
Other bias	Unclear risk	Abstract only with sparse data.

Bogaerts 2012

Methods	3-arm RCT conducted in University hospital, Leuven and East Limburg Hospital Belgium.
Participants	<p>Inclusion criteria: obese pregnant women.</p> <p>Exclusion criteria: NR.</p>
Interventions	Counselling involving psycho-education (4 sessions) vs a brochure vs control.

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Bogaerts 2012 (Continued)

Control group: routine care.

Outcomes	GWG and psychological vulnerability (depression and anxiety).
Notes	<p>Data collected during the first, second and third trimester. They found a significant reduction in GWG in the brochure and prenatal groups compared with controls. No differences in delivery method, birth-weight, anxiety or depressed mood noted.</p> <p>Authors concluded that: findings justify "the clinical implementation of a psycho-educational program in order to reduce GWG and psychological vulnerability in obese pregnant women".</p>

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	"women were randomised."
Allocation concealment (selection bias)	Unclear risk	Not described.
Blinding of participants and personnel (performance bias) All outcomes	Unclear risk	Not described.
Blinding of outcome assessment (detection bias) All outcomes	Unclear risk	Not described.
Incomplete outcome data (attrition bias) All outcomes	Unclear risk	Details not provided.
Selective reporting (reporting bias)	Unclear risk	Abstract only with little data.
Other bias	Unclear risk	Abstract only with little data.

Callaway 2010

Methods	RCT, set in a hospital in Brisbane, Australia.
Participants	<p>50 women randomised.</p> <p>Inclusion criteria: obese pregnant women were recruited at 12 weeks' gestation, aged 18-45, BMI ≥ 30 kg/m², pregnancy care at study hospital, willing and able to be randomised to an exercise intervention.</p> <p>Exclusion criteria: non-English speaking, contraindication or inability to exercise, medical or obstetric contraindication to exercise including haemodynamically significant heart disease, restrictive lung disease, incompetent cervix (cerclage), multiple gestation, severe anaemia, chronic bronchitis, type 1 diabetes, orthopaedic limitations, poorly controlled seizure disorder, poorly controlled hyperthyroidism, or a heavy smoker.</p>
Interventions	Intervention group: the intervention group received an individualised exercise program with an energy expenditure (EE) goal of 900 kcal/ week. Advice from physiotherapist and diaries for self-monitoring.

Callaway 2010 (Continued)

Control group: routine obstetric care.

Outcomes Self-report of exercise (behaviour change).

Notes

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Randomisation was by a random number allocation technique conducted by a 3rd party.
Allocation concealment (selection bias)	Unclear risk	Not clear but external randomisation.
Blinding of participants and personnel (performance bias) All outcomes	High risk	No blinding.
Blinding of outcome assessment (detection bias) All outcomes	Unclear risk	No blinding. The impact of the lack of blinding was not clear. The use of self-monitoring diaries by the intervention group may have introduced recall bias.
Incomplete outcome data (attrition bias) All outcomes	High risk	Randomised 50 women, at 36 weeks 36 were followed up (30% attrition).
Selective reporting (reporting bias)	Unclear risk	Assessment from published study report and online supplement.
Other bias	Unclear risk	"There were no statistically significant differences between the intervention and control groups in any baseline variable." Different monitoring techniques in the 2 groups (diaries in the intervention group) may have led to recall bias.

Clapp 2002a

Methods A prospective randomised design.

Participants 20 healthy women with uncomplicated pregnancy.

Interventions The participants were enrolled prior to pregnancy and placed on a regular regimen of supervised exercise and began a weight maintaining diet (low glycaemic sources of CHO). At 8 weeks' gestation, they were randomised to either diet containing low glycaemic CHO sources (n = 10) (aboriginal CHO diet) or high glycaemic CHO sources (n = 10) (cafeteria CHO diet). All continued the same exercise regimen throughout pregnancy.

Outcomes Weight gain.

Total weight gain was defined as weight at delivery minus prepregnancy weight.

Notes During pregnancy, all women were allowed to increase caloric intake according to appetite with advancing gestation.

Risk of bias

Clapp 2002a (Continued)

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Not described.
Allocation concealment (selection bias)	Unclear risk	No information provided.
Blinding of participants and personnel (performance bias) All outcomes	Unclear risk	Not described.
Blinding of outcome assessment (detection bias) All outcomes	Unclear risk	Not described.
Incomplete outcome data (attrition bias) All outcomes	Unclear risk	Unspecified loss to follow-up.
Selective reporting (reporting bias)	High risk	Outcomes not prespecified and appear to be selected.
Other bias	Unclear risk	Poorly reported.

Clapp 2002b

Methods	RCT, set in Case Western Reserve University at metro health medical centre, USA.
Participants	<p>Inclusion criteria: 80 healthy, regularly exercising (≥ 3 times/week), non-substance-abusing women were enrolled before pregnancy.</p> <p>After conception (which occurred within 4 months in all cases) and ultrasonic confirmation of a viable singleton pregnancy, these women were assigned in week 8 of gestation to the exercise regimens.</p> <p>Exclusion criteria: not stated.</p> <p>Number of participants: 75 women enrolled and complete the protocol; 26 in Lo-Hi group, 24 in Mo-Mo group, 25 in Hi-Lo group.</p>
Interventions	<p>There were 3 study groups:</p> <p>group 1: low-high exercise (n = 26): exercise 20 mins 5 days a week through to week 20, gradually increasing to 60 mins 5 days a week by week 24 and maintaining that regimen until delivery (Lo-Hi);</p> <p>group 2: moderate-moderate exercise (n = 24): exercise 40 mins 5 days a week from week 8 until delivery (Mod-Mod);</p> <p>group 3: high-low exercise (n = 25): exercise 60 mins 5 days a week through to week 20, gradually decreasing to 20 mins 5 days a week by week 24 and maintaining that regimen until delivery (Hi-Lo).</p>
Outcomes	Weight gain.
Notes	Age 31 ± 1 , 30 ± 1 , 32 ± 1 in Lo-Hi, Mo-Mo, Hi-Lo.

Risk of bias
Diet or exercise, or both, for preventing excessive weight gain in pregnancy (Review)

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Clapp 2002b (Continued)

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Women were randomly assigned.
Allocation concealment (selection bias)	Unclear risk	Women were randomly assigned by envelope but it was not stated whether envelopes were sequentially numbered, opaque and sealed.
Blinding of participants and personnel (performance bias) All outcomes	Unclear risk	Not described.
Blinding of outcome assessment (detection bias) All outcomes	High risk	A member of the study team carried out morphometric assessment of placenta and infant at the time of birth.
Incomplete outcome data (attrition bias) All outcomes	Low risk	Loss to follow-up 6.25%.
Selective reporting (reporting bias)	Unclear risk	Could not determine.
Other bias	Low risk	Baseline data were similar.

Cordero 2014

Methods	Open-label RCT conducted at Hospital Puerta de Hierro, Madrid, Spain.
Participants	342 randomised, 257 women analysed. Included pregnant women in Spain at 10-12 weeks according to ultrasound, with no medical or obstetric contraindications to exercise. Excluded women with medical or obstetric contraindications.
Interventions	Intervention group (101 women): a supervised exercise program consisting of aerobic and toning exercises for 3 sessions per week. 2 weekly sessions were performed on land (60 min) and 1 session was aquatic based (50 min). Program commenced from 10-14 weeks to the end of the third trimester. Sessions were supervised by a qualified fitness specialist and an obstetrician. Control group (156 women): routine care.
Outcomes	GDM (primary outcome, diagnosed by fasting GTT before 30 weeks' gestation, according to medical records). Excessive GWG, gestational age at delivery, mode of delivery, birthweight and length, SGA, macrosomia.
Notes	Enrolment age (intervention, control): 33.6 ± 4.1, 32.9 ± 4.5. Enrolment gestational age (intervention, control): NR. Prepregnancy BMI (intervention, control): 22.5 ± 3.2, 23.6 ± 4. NCT01790412.

Risk of bias
Diet or exercise, or both, for preventing excessive weight gain in pregnancy (Review)

Cordero 2014 (Continued)

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Sequence generation and ratio was not described.
Allocation concealment (selection bias)	Unclear risk	Not described.
Blinding of participants and personnel (performance bias) All outcomes	High risk	Open-label.
Blinding of outcome assessment (detection bias) All outcomes	Unclear risk	Insufficient detail in report.
Incomplete outcome data (attrition bias) All outcomes	High risk	Attrition of 21 women (16.4%) in the intervention group and 64 in the control group (29.1%).
Selective reporting (reporting bias)	High risk	Per protocol analysis performed based on adherence to exercise "A minimum of 80% adherence to exercise classes was required for women assigned to the intervention group". Excluded women with poor adherence, and those who developed hypertension or were at risk of preterm labour. Possible side effects of exercise, e.g. preterm labour, were NR.
Other bias	High risk	Sample sizes differed substantially (101 and 156 women in intervention and control groups, respectively). For intervention and control groups, respectively, 2.7% vs 4.8% had previous GDM. 17.8% vs 27.6% had sedentary lifestyles before pregnancy. These might have biased GDM and GWG results in favour of the intervention group.

De Oliveria Melo 2012

Methods	Open-label 3-arm RCT conducted at Department of Obstetrics, University of Campinas in Brazil with recruitment from May 2008 to Sept 2010.
Participants	General population, 187 randomised. Inclusion criteria: healthy pregnant women who were sedentary at admission to the study, gestational age 13 weeks or less confirmed by ultrasonography and with single live fetus. Exclusion criteria: excluded if smoked, chronic diseases, a history of premature delivery, fetal abnormalities, placenta previa, a history of vaginal bleeding, placental detachment, and cervical length less than 2.5 cm.
Interventions	Intervention group: exercise (initiated at 13 weeks) (n = 62) vs exercise (initiated at 20 weeks) (n = 63) vs control (n = 62). Exercise consisted of walking 3 times a week. Control group: routine care.
Outcomes	Uteroplacental blood flow, birthweight, pre-eclampsia, fetal growth restriction, macrosomia (assessed by ultrasound at 38 weeks), LGA and SGA at birth.
Notes	Fitness evaluated at 13, 20 and 28 weeks.

De Oliveria Melo 2012 (Continued)

Age (intervention 1, intervention 2, control): 24 [5.8]/26 [5.3]/24 [5.4].

Enrolment gestational age: ≤ 13 weeks.

Prepregnancy BMI (intervention 1, intervention 2, control): 24.7 [4.3]/23.4 [3.8]/23.5 [3.5].

Authors concluded that "Moderate intensity walking improved the physical fitness level of healthy pregnant previously sedentary women without affecting feto-placental blood flow or fetal growth".

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	"Randomisation sequence generated in blocks of ten" using Random Allocation software program 1.0."
Allocation concealment (selection bias)	Low risk	Sealed opaque envelopes. "Groups were assigned only after the woman agreed to participate."
Blinding of participants and personnel (performance bias) All outcomes	High risk	Open-label.
Blinding of outcome assessment (detection bias) All outcomes	Low risk	"Investigators involved in monitoring and ...analysis were unaware of the group to which the patient had been assigned."
Incomplete outcome data (attrition bias) All outcomes	Unclear risk	16 women declined to participate after randomisation (8.5%). 31 women (19%) were missing follow-up data for the 38 week visit; these missing data were balanced across study arms. Delivery/birth data were available for 161/187 women (86%).
Selective reporting (reporting bias)	Unclear risk	Protocol not seen.
Other bias	Low risk	None noted. Baseline characteristics similar.

Di Carlo 2014

Methods	RCT at antenatal clinic in Italy from January 2010 to January 2011.
Participants	<p>General population, 154 randomised, 120 analysed.</p> <p>Inclusion criteria: pregnant at 6-13 weeks' gestation (median 8 weeks). Women were excluded if they had any significant maternal condition.</p> <p>Exclusion criteria: any significant maternal condition including essential hypertension, thyroid diseases, gestational diabetes, miscarriages, preterm births, multiple pregnancies with more than 2 fetuses, maternal BMI ≤ 20 and ≥ 40 kg/m².</p>
Interventions	<p>Intervention group: dietary intervention (personalised diet plan with monthly dietician supervision) (n = 77; 59 in final analysis).</p> <p>Control group: brochure on healthy eating (n = 77; 61 in final analysis).</p>
Outcomes	Weight gain, birthweight.

Di Carlo 2014 (Continued)

Notes

Age (intervention, control): 31.3 [4.7]/28.2 [5.3] (P = 0.002).

Enrolment gestational age: 8-13 weeks (median 8 weeks).

Prepregnancy BMI: 26.5 [6.3]/25 [4.2] (P = 0.3).

Authors concluded that "This study suggests that a personalised nutritional intervention, in which the dietician plays an active role within the obstetric team, may represent a successful approach to limiting weight gain in pregnant women".

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	"Randomly allocated" in 1:1 ratio.
Allocation concealment (selection bias)	Low risk	"...attached a sequentially numbered, opaque sealed and stapled envelope containing the allocation treatment to the patient clinical record."
Blinding of participants and personnel (performance bias) All outcomes	High risk	Participants not blinded due to nature of intervention.
Blinding of outcome assessment (detection bias) All outcomes	Low risk	"The allocation sequence was concealed from the researchers."
Incomplete outcome data (attrition bias) All outcomes	High risk	22% of participants were excluded due to miscarriages (9 vs 8 in diet and control groups respectively), loss to follow-up (6 vs 7) and preterm births (3 vs 1). "Analysis was performed per protocol" but protocol deviations and individual denominators were NR.
Selective reporting (reporting bias)	High risk	Per protocol data reported with individual denominators missing from most results. Results not adjusted for baseline difference in maternal age (older in the intervention group).
Other bias	High risk	Baseline difference in age of women (average of 3 years older in intervention group).

Dodd 2014

Methods	RCT at 3 public maternity hospitals, Adelaide in Australia from June 2008 to December 2011.
Participants	High risk (overweight and obese), 2212. Inclusion criteria: women with a singleton pregnancy, between 10 + 0 and 20 + 0 weeks' gestation, and BMI \geq 25. Exclusion criteria: women with type 1 and 2 diabetes were ineligible.
Interventions	Intervention group: comprehensive dietary and lifestyle intervention (counselling) (n = 1108) Intervention involved meetings and home visits with advice on dietary, exercise, and behavioural strategies delivered by a dietician and trained research assistants. Exercise advice primarily encouraged women to increase their amount of walking and incidental activity. Control group: routine care (n = 1104).

Diet or exercise, or both, for preventing excessive weight gain in pregnancy (Review)

Dodd 2014 (Continued)

A nested RCT was also conducted in which women randomised to the intervention group were further randomised to receive written/verbal education about physical activity (n = 295) or to participate in a supervised walking group of moderate intensity 3 times per week for 40 mins (n = 287).

Outcomes	Primary outcome measures are: incidence of infants born LGA (birthweight \geq 90th centile for gestation and sex). Secondary outcomes included birthweight > 4000 g, hypertension, pre-eclampsia, and gestational diabetes.
Notes	<p>Age (intervention, control): 29.3 [5.4]/29.6 [5.3].</p> <p>Enrolment gestational age (intervention, control): 14 (11.9-17)/14.1 (11.9-17).</p> <p>Recruitment BMI: 31 (28.1-35.9)/31.1 (27.7-35.6).</p> <p>Authors concluded that "For women who were overweight or obese, the antenatal lifestyle advice used in the study did not reduce the risk of delivering a baby weighing above the 90th centile for gestational age and sex or improve maternal pregnancy and birth outcomes".</p>

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	"The computer generated randomisation schedule used balanced variable blocks in the ratio 1:1". The investigator who prepared the randomisation schedule also was not involved with the recruitment or clinical care.
Allocation concealment (selection bias)	Low risk	"Telephoning the central randomisation service."
Blinding of participants and personnel (performance bias) All outcomes	High risk	Not feasible to blind participants.
Blinding of outcome assessment (detection bias) All outcomes	Low risk	Follow-up done by interviewers not involved with the trial.
Incomplete outcome data (attrition bias) All outcomes	Low risk	< 20% missing data for all outcomes.
Selective reporting (reporting bias)	Low risk	All outcomes reported according to protocol.
Other bias	Low risk	None noted. Baseline characteristics comparable.

Ferrara 2011

Methods	RCT at Kaiser Permanente Medical Care Program of Northern California in USA from October 2005 and May 2008.
Participants	<p>High risk (GDM), 197 randomised.</p> <p>Inclusion criteria: women with GDM.</p>

Ferrara 2011 (Continued)

Exclusion criteria: age < 18 years; multiple gestation; diagnosis of diabetic retinopathy; high-risk pregnancy (i.e. drug or alcohol abuse, chronic health problems, or pregnancy complications); thyroid diseases diagnosed in the last 30 days; and non-English speaker.

Interventions	<p>Intervention group: lifestyle intervention called DEBI (n = 96). Lifestyle intervention involved 3 in-person sessions and up to 15 telephone calls with counselling re diet, physical activity and breastfeeding up to 12 months postpartum. The intervention was delivered by 2 dietitians. Participants were encouraged to engage in moderate intensity physical activity for 150 mins per week and received written materials about food size, foods with low GI or low fat, and how to read food labels were discussed.</p> <p>Control group: routine care (n = 101).</p>
Outcomes	Meeting a set postpartum weight goal, weight gain, birthweight and breastfeeding.
Notes	<p>Data collected at baseline (GDM diagnosis) and at 6 weeks, 7 months and 12 months.</p> <p>Enrolment gestational age (intervention, control): 31 [5.6]/31 [6.1].</p> <p>Authors concluded that: "This study suggests that a lifestyle intervention that starts during pregnancy and continues postpartum is feasible and may prevent pregnancy weight retention and help overweight women lose weight. Strategies to help postpartum women overcome barriers to increasing physical activity are needed".</p>

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	"A computer randomisation program was used to ensure that the conditions remained balanced with regards to the following characteristics: age (< 30 and ≥ 30 years), parity (≤ 1 and < 1), pregravid BMI (< 27.0 and ≥ 27 kg/m ²)."
Allocation concealment (selection bias)	Unclear risk	Not described.
Blinding of participants and personnel (performance bias) All outcomes	High risk	Participants not blinded due to nature of intervention.
Blinding of outcome assessment (detection bias) All outcomes	Low risk	"data were collected by research assistants who were unaware of the condition assignment."
Incomplete outcome data (attrition bias) All outcomes	High risk	20% attrition at 7 and 12 months follow-up with great loss to follow-up in the intervention groups. This could bias results in the direction of the intervention if the heavier women chose to drop out.
Selective reporting (reporting bias)	Unclear risk	Protocol not seen. GWG was NR.
Other bias	Low risk	Baseline characteristics comparable.

Guelinckx 2010

Methods	RCT, set in the prenatal clinic, University Hospital of Leuven, Belgium.
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Guelinckx 2010 (Continued)

Participants	<p>Inclusion criteria: obese (BMI > 29.0 according to IOM criteria), white women consecutively attending the prenatal clinic before 15 week of gestation.</p> <p>Exclusion criteria: pre-existing diabetes or developing GDM, multiple pregnancy, recruitment after 15 weeks of gestational age, premature labour (delivery before 37 week of gestation), primary need for nutritional advice in case of a metabolic disorder, kidney problems, Crohn's disease, allergic conditions, and inadequate knowledge of the Dutch language.</p>
Interventions	<p>2 intervention groups: the passive group (n = 37): received a brochure during the 1st prenatal consultation. This brochure was specifically designed for the study and provided advice on nutrition and on physical activity and tips to limit pregnancy-related weight gain. The active group (n = 42): received the same brochure and women were actively counselled by a trained nutritionist in 3 group sessions. A maximum of 5 women were brought together in these 1-hour sessions, which were scheduled at 15, 20, and 32 weeks of pregnancy. The sessions provided participants with recommendations on a balanced, healthy diet, based on the Official National Dietary Recommendations (9%–11% of the energy should come from proteins, 30%–35% from fat, and 50%–55% from CHOs).</p> <p>Control group (n = 43): received routine prenatal care.</p> <p>(Energy intake was not restricted in any group.)</p>
Outcomes	<p>Excessive weight gain (weight gain more than the upper limit recommendation for overweight women; > 11.2 kg).</p> <p>Gestational weight gain.</p> <p>Obstetrical and neonatal outcome: pre-eclampsia, induction of labour, caesarean section, birthweight > 4000 g.</p> <p>Average energy intake.</p> <p>Weight gain was defined as weight at birth minus prepregnancy weight.</p> <p>Total physical activity score at 3rd trimester.</p> <p>For analysis 3.10 and 4.10 a physical activity score was calculated by using a questionnaire including a total 16 questions classified into 3 domains: work, sports, and non-sports leisure-time activities, scored on a 5-point scale, ranging from “never”, “seldom”, “sometimes”, “very often”, to “always”. A total score for physical activity from a minimum of 3 to a maximum of 15 was obtained. A higher score indicated more activity.</p>
Notes	<p>Age 29.4 ± 4.4, 28.7 ± 4.0, 28.0 ± 3.6 years for control group, passive group, active group.</p> <p>Enrolment gestational age: 10.2 ± 2.4, 10.2 ± 2.6, 9.3 ± 2.8 weeks for control group, passive group, active group.</p> <p>Prepregnancy BMI: 33.5 ± 3.9, 33.4 ± 3.07, 34.1 ± 4.5 kg/m² for control group, passive group, active group.</p>

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	No information provided.
Allocation concealment (selection bias)	Low risk	Patients were randomly assigned by using block randomisation.

Guelinckx 2010 (Continued)

Blinding of participants and personnel (performance bias) All outcomes	Unclear risk	Not described.
Blinding of outcome assessment (detection bias) All outcomes	Unclear risk	Not described.
Incomplete outcome data (attrition bias) All outcomes	Low risk	Loss to follow-up 9.7%. Reasons for excluding the participants from each group were similar.
Selective reporting (reporting bias)	Unclear risk	Could not determine.
Other bias	Low risk	Baseline characteristics of participants were similar between intervention and control groups.

Haakstad 2011

Methods	Parallel-arm RCT at Norwegian School of Sport Sciences in Norway from September 2007-March 2008.
Participants	<p>General population, 105.</p> <p>Inclusion criteria: ability to speak Norwegian; nulliparous, sedentary women whose exercise levels did not include participation in a structured exercise program including brisk walks for the past 6 months were eligible for the trial, and must be in their first 24 weeks of pregnancy.</p> <p>Exclusion criteria: history of more than 2 miscarriages, severe heart disease (including symptoms of angina, myocardial infarction or arrhythmias), persistent bleeding after 12 weeks of gestation, multiple pregnancy, poorly controlled thyroid disease, pregnancy-induced hypertension or pre-eclampsia, diabetes or gestational diabetes, and other diseases that could easily interfere with participation.</p>
Interventions	<p>Intervention group: exercise (60 min supervised aerobic dance at least twice a week for a minimum of 12 weeks) (n = 52). Women in the exercise group were advised to have moderate, self-imposed physical activity on the remaining weekdays.</p> <p>Control group: routine care (n = 53).</p>
Outcomes	Infant birthweight, excessive weight gain, postpartum weight retention. Maternal weight gain and the proportion of women with excessive weight gain according to IOM recommendations (used self-reported pre-pregnancy weight as baseline).
Notes	<p>Participants were assessed 3 times: first visit (12-24 weeks), second visit (36-38 weeks) and last visit (6-12 weeks postpartum). Adherence was a problem - 31 (60%) women attended less than 80% of the exercise sessions and 4 women never showed up. Investigators performed subgroup analysis of participants who attended more than 24 sessions and the difference was significant in this subgroup of 21 women vs 53 controls (GWG 11.0 vs 13.8; P = 0.01). No women in this group had excessive weight gain (P = 0.006).</p> <p>Age (intervention, control): 31.2 [3.7]/30.3 [4.4].</p> <p>Enrolment gestational age (intervention, control): 17.3 [4.1]/18 [4.3].</p> <p>Prepregnancy BMI: 23.8 [3.8]/23.9 [4.7].</p>

Haakstad 2011 (Continued)

Authors concluded that "Regular participation in aerobic dance exercise can contribute to significantly reduced weight gain in pregnancy." However, "not associated with a reduction in birth weight".

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Used "a simple (not block) computerised randomisation programme".
Allocation concealment (selection bias)	Low risk	"An independent person...assigned the participants to either an exercise group or a control group."
Blinding of participants and personnel (performance bias) All outcomes	Low risk	Participant blinding not possible but principal investigator was blinded to group allocation.
Blinding of outcome assessment (detection bias) All outcomes	Low risk	"Assessor blinded". The principal investigator was "blinded to group allocation when assessing the outcome measures".
Incomplete outcome data (attrition bias) All outcomes	Low risk	Drop-out rates of 19% and 21% in exercise and control arms, respectively. Drop-outs were due to pain, hypertension, preterm birth and other reasons and were similar between the study arms.
Selective reporting (reporting bias)	Unclear risk	Could not determine.
Other bias	Unclear risk	Denominators in report tables were the total exercise and control group N, despite stating drop-outs in each group of 10 and 11 women, respectively.

Harrison 2013

Methods	RCT at 3 large tertiary hospitals in Victoria, Australia.
Participants	High risk, 228 randomised; 203 analysed. Inclusion criteria: women 12-15 weeks of gestation, overweight (BMI ≥ 25 or ≥ 23 kg/m ²) if high risk ethnicity (Polyasian, Asian, African populations) or obese (BMI ≥ 30 kg/m ²), and at the increased risk for developing GDM identified by validated risk prediction tool. Exclusion criteria: exclusion criteria included multiple pregnancies, diagnosed type 1 or 2 diabetes, a BMI ≥ 45 kg/m ² , a pre-existing chronic medical condition, and non-English speaking women.
Interventions	Intervention group: lifestyle counselling intervention program (individual 4 sessions based on Social Cognitive Theory provided by a health coach) (n = 121) Intervention provided dietary advice, simple healthy eating, and "physical activity messages" and weight gain self-monitoring. Also included "regular self-weighing as a key behavioural strategy". Control group: routine care (n = 107).
Outcomes	The primary outcome was GWG with secondary outcomes including GDM screening.
Notes	Outcomes were assessed at 12-15 and 26-28 weeks' gestation. Postpartum outcomes NR in primary report.

Harrison 2013 (Continued)

Age (intervention, control): 32.4 [4.6]/31.7 [4.5].

Enrolment gestational age (overall): 14 [0.8].

Recruitment BMI: 30.4 [5.6]/30.3 [5.9].

Authors concluded that "Results indicate that a low-intensity lifestyle intervention, integrated with antenatal care, optimizes healthy GWG and attenuates physical activity decline in early pregnancy

Efficacy in limiting weight gain was greatest in overweight women and in high-risk ethnically diverse women".

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	"Randomly assigned ...through computer-generated randomised sequencing."
Allocation concealment (selection bias)	Unclear risk	"Sealed opaque envelopes."
Blinding of participants and personnel (performance bias) All outcomes	Low risk	"Care providers...were blinded to group allocation."
Blinding of outcome assessment (detection bias) All outcomes	Low risk	"Participants wore a blinded pedometer" and "investigators and outcome data analysers were blinded to group allocation."
Incomplete outcome data (attrition bias) All outcomes	Low risk	Loss to follow-up was similar in the 2 groups and < 20% for primary outcomes. Pedometer (PA) outcomes showed high loss to follow-up; therefore we did not use these data.
Selective reporting (reporting bias)	Unclear risk	Could not determine.
Other bias	Unclear risk	Follow-up weight gain data were collected at 28 weeks (much earlier than other included studies).

Hawkins 2014

Methods	Parallel arm pilot RCT. Conducted at medical centres in Western Massachusetts, USA. Recruitment from April 2010 to Aug 2011.
Participants	<p>68 high-risk (overweight and obese) pregnant women randomised.</p> <p>Overweight and obese pregnant Hispanic women (pre-pregnancy BMI > 25 kg/m²) aged 18–40 years, with a gestational age of < 18 weeks, and who self-reported participating in < 30 mins of moderate-intensity activity per week.</p> <p>Excluded if history of Type 2 diabetes, hypertension, heart disease or chronic renal disease; current medications that adversely influence glucose tolerance; contraindications to participating in moderate-intensity physical activity or a low-fat/high-fibre diet; self-reported participation in > 30 min of moderate-intensity exercise on > 3 days/week or > 20 min of vigorous-intensity exercise on > 1 day/week; or 6) multiple gestation (e.g. twins).</p>

Hawkins 2014 (Continued)

Interventions A lifestyle intervention (n = 33), consisting of a culturally and linguistically modified, motivationally targeted, individually tailored 6-month prenatal programme. Educators encouraged women to achieve guidelines for physical activity, decrease saturated fat and increase dietary fibre. The intervention consisted of 6 monthly in-person behavioural counselling sessions and 5 telephone booster sessions with follow-up to 6 weeks postpartum. Women were encourage to achieve ≥ 30 min of moderate-intensity activity on most days of the week through walking and developing a more active lifestyle.

Controls had routine care (n = 35).

Outcomes GWG, infant birthweight and biomarkers of insulin resistance.

Notes Mean recruitment age and BMI not given; these baseline variables were stratified and reported as categorical variables. Mean recruitment age was 14.9 weeks overall. Group characteristics were similar.

Exercise outcomes were reported for 24-28 weeks' gestation and at 6 weeks' postpartum.

"Findings suggest that a motivationally matched lifestyle intervention is feasible and may help attenuate pregnancy-related decreases in vigorous physical activity in a population of overweight and obese Hispanic women." NCT01141582.

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	"randomisation was stratified by age and prepregnancy BMI with a block size of four."
Allocation concealment (selection bias)	Unclear risk	Not described.
Blinding of participants and personnel (performance bias) All outcomes	Unclear risk	Not clearly described.
Blinding of outcome assessment (detection bias) All outcomes	Low risk	Assessors blinded to the assigned intervention group.
Incomplete outcome data (attrition bias) All outcomes	Low risk	Low attrition.
Selective reporting (reporting bias)	Unclear risk	Birth outcomes other than birthweight, and maternal weight at 6 weeks postpartum, were NR.
Other bias	Low risk	Baseline characteristics similar. Analysis by ITT.

Huang 2011

Methods RCT; 3 groups intervention design; 2 experimental groups (from pregnancy to 6 months postpartum (EP) and from birth to 6 months postpartum (EPP). The group receiving the intervention in the postnatal period only is not included in our analysis) and 1 comparison group.

Participants From January to June 2006, pregnant women were recruited from the obstetric clinics of a hospital in Taiwan (160 women randomised).

Huang 2011 (Continued)

Inclusion criteria: 16 gestational weeks, age 18 years or older, no cognitive impairment or psychiatric illness, ability to speak and read Chinese, not participating in another study, and intention to give birth at the study site.

Interventions

Intervention group: (80 participants). The educational intervention began at 16 gestational weeks (baseline) and to 6 months postpartum. The intervention was delivered at regularly scheduled clinic visits by nurses with training in nutrition and physical fitness. The nurse discussed with each participant how to design an individualised diet and physical activity plan. The intervention consisted of 6 1-to-1 counselling sessions: 1 primary session (about 30–40 mins) at the 16-week gestation visit, and 5, 1-to-1 booster sessions (at 28 gestational weeks, 36–38 gestational weeks, before hospital discharge after a 3–7-day stay, 6 weeks' postpartum and 3 months postpartum). After each clinic visit, women in the experimental groups were sent a personalised graph of their weight changes. At the 1st session, the experimental groups also received a researcher-prepared brochure that provided detailed information on weight management goals during pregnancy and postpartum.

Control group: (80 participants) routine care, provided once each trimester, which included health education on nutrition and exercise during pregnancy.

Outcomes

GWG, weight retention at 6 months postpartum, health-promoting behaviour; physical activity.

For analysis 1.9.1 physical activity measurement was a part of the health-promoting lifestyle profile composed of 50-item scale uses a 4-point response format (range = 50–200) to measure the frequency of engaging in activities related to self-actualisation, nutrition, physical activity, interpersonal support, health responsibility and stress management.

Notes
Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Using a table of random numbers.
Allocation concealment (selection bias)	Unclear risk	Not stated.
Blinding of participants and personnel (performance bias) All outcomes	Unclear risk	Not described.
Blinding of outcome assessment (detection bias) All outcomes	Low risk	The research assistant collecting outcome data was reported to be blind to the group assignments.
Incomplete outcome data (attrition bias) All outcomes	Unclear risk	80 women in each group were randomised, 61 and 64 of intervention and control group were analysed (78% followed up).
Selective reporting (reporting bias)	Unclear risk	Assessment from published study report.
Other bias	Low risk	No notable baseline differences were found between groups.

Hui 2006

Methods	RCT, set in a community nurse-managed centre and the Manitoba Clinic, both in urban Winnipeg, Manitoba, Canada.
Participants	<p>Inclusion criteria: women < 26 weeks pregnant with no pre-existing diabetes were recruited on a voluntary basis.</p> <p>Exclusion criteria: pregnant women who had medical obstetric, skeletal or muscular disorders that could contraindicate physical exercise during pregnancy.</p>
Interventions	<p>Intervention (n = 24): additional intervention: lifestyle intervention including exercise intervention and dietary intervention.</p> <p>Exercise intervention: participants were instructed in group-session exercises and in home-based exercise. Weekly group session included floor aerobics, stretching and strength exercises, 3-5 times/week for 30-45 mins per session, video provided to participants to assist with home-based exercise.</p> <p>Nutrition intervention: computer-assisted food choice map interview, dieticians provided a personalised plan for participants.</p> <p>Control (n = 21): standard care group received an information package on diet and physical activity for a healthy pregnancy.</p>
Outcomes	<p>Excessive weight gain, weight gain, caesarean section, infant birthweight > 4000 g, and physical activity at end of study.</p> <p>Weight gain was defined as weight at birth (from medical chart) minus prepregnancy weight.</p> <p>For analysis 1.9.1 physical activity was defined as recreational physical activity which was measured by using the PARmed-X for Pregnancy form based on Health Canada recommendations. Low levels (physical activity = 0) are defined as either no physical activity or activity < 1 to 2 times per week and for < 20 min per session; moderate levels (physical activity = 1) are defined as activity 1 to 2 times per week and for > 20 min per session or > 2 times per week and for < 20 min per session; high level (physical activity = 2) are defined as activity > 2 times per week and for > 20 min per session.</p>
Notes	<p>Age (intervention, control): 26.2 ± 5.7, 26.2 ± 5.4.</p> <p>Prepregnancy BMI (intervention, control): 25 ± 6.3, 23.4 ± 3.9 kg/m².</p> <p>Excessive weight gain was assessed based on prepregnant BMI:</p> <ul style="list-style-type: none"> • BMI < 20 kg/m², weight gain during pregnancy 12.5 -18 kg; • BMI 20-27 kg/m², upper limit of weight gain 16 kg; • BMI > 27 kg/m², upper limit of weight gain 11.5 kg. <p>(Canadian guidelines for healthy weights)</p> <p>Majority of participants (89%) were from low-income families or low-middle income families.</p>

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Participants were enrolled and randomised into additional intervention and standard care groups.
Allocation concealment (selection bias)	Unclear risk	No information provided.
Blinding of participants and personnel (performance bias)	Unclear risk	Not described.

Diet or exercise, or both, for preventing excessive weight gain in pregnancy (Review)

Hui 2006 (Continued)

All outcomes

Blinding of outcome assessment (detection bias) All outcomes	Unclear risk	Not described.
Incomplete outcome data (attrition bias) All outcomes	Unclear risk	52 enrolled, 45 completed. Loss = $7/52 \times 100 = 13.5\%$; 7 pregnant women dropped out due to school or work commitments. The participants who dropped out were significantly younger and had lower incomes than those who completed the program ($P < 0.01$).
Selective reporting (reporting bias)	Unclear risk	Could not determine.
Other bias	Low risk	No significant differences were found in age, prepregnancy BMI, and family income between additional intervention and standard care groups.

Hui 2012

Methods	RCT at Tertiary hospital, Winipeg, Canada, from July 2004 to February 2010.	
Participants	General population, 224 randomised, 190 completed the study (88 controls and 102 interventions). Inclusion criteria: non-diabetic pregnant women living in Winnipeg, < 26 weeks' gestation, signed informed consent. Exclusion criteria: medical or obstetric contraindications to exercise during pregnancy.	
Interventions	Intervention group: lifestyle intervention (diet counselling and an exercise program) (n = 112) Intervention included "a community-based exercise program specifically designed for pregnant women was provided". An exercise regimen, 3 to 5 times per week including a weekly exercise session and multiple home sessions of mild-to-moderate exercise for 30 to 45 mins was recommended. Program started between 20-26 weeks. Group exercise sessions including aerobics were held in community centres and instructors were licensed fitness trainers. 2 dietary interviews with counselling were provided. Control group: routine care (n = 112).	
Outcomes	Primary outcome - prevalence of excessive GWG and measures of physical activity and food intake between the 2 groups. Other measures included physical activity, gestational diabetes, weight-related obstetric procedures, gestational weight gain, the prevalence for LGA and birthweights.	
Notes	Participants logbooks were collected weekly. Delivery data and maternal weight at delivery were collected from medical records. Age (intervention, control): 30.1 [5.2]/28.7 [5.9]. Enrolment gestational age given as < 26 weeks' gestation. Prepregnancy BMI: 24.9 [5.4]/25.7 [5.1]. Authors concluded that a "lifestyle intervention during pregnancy increased physical activity, improved dietary habits and reduced excessive GWG in urban-living pregnant women".	

Risk of bias

Bias	Authors' judgement	Support for judgement
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Hui 2012 (Continued)

Random sequence generation (selection bias)	Low risk	"Randomisation was performed using a computer-generated randomisation allocation table by a staff member without involvement in the study design."
Allocation concealment (selection bias)	Low risk	"After randomisation, participants received a sealed envelope labelled with the assigned randomisation number."
Blinding of participants and personnel (performance bias) All outcomes	High risk	"The study staff were not blinded to the types of intervention."
Blinding of outcome assessment (detection bias) All outcomes	High risk	"The study staff were not blinded to the types of intervention."
Incomplete outcome data (attrition bias) All outcomes	Unclear risk	Low risk for primary outcomes - 30 participants (15%) withdrew from the study (7 in intervention group and 23 in the control group). However, only half the women completed dietary logbooks, so these data could not be used.
Selective reporting (reporting bias)	Unclear risk	Could not determine.
Other bias	Low risk	None noted. Baseline characteristics comparable.

Hui 2014

Methods	Parallel arm RCT conducted in Winnipeg, Canada between May 2009 and December 2011.
Participants	116 normal and high BMI women were randomised (BMI < 25 and BMI > 25), 113 analysed. Included if < 20 weeks' gestation, no existing GDM. Excluded if they had medical or obstetric contraindications to exercise during pregnancy.
Interventions	Lifestyle intervention (diet counselling and a supervised exercise program) (n = 57) vs control (n = 56). Intervention included "a community-based exercise program specifically designed for pregnant women was provided". An exercise regimen, 3 to 5 times per week including a weekly exercise session and home sessions with DVD instruction of mild to moderate aerobic exercise for 30 to 45 mins was recommended. Program started between 20-26 weeks and continues to 36 weeks. Group exercise sessions including aerobics were held in community centres and instructors were licensed fitness trainers. 2 dietary interviews with dietician counselling using a Food Choice Map were provided (baseline and 2 months later). Control group received standard care.
Outcomes	GWG, birthweight, delivery route, physical activity and food intake, gestational diabetes, LGA.
Notes	Investigators stratified results by BMI (< 25 and > 25 kgm ²). Recruitment age: overweight group 31 [4]/32 [5]; normal weight group 31 [3]/29 [6]. Gestational age: < 26 weeks. Recruitment BMI: overweight group 29.5 [5.1]/ 29.7 [1.3]; normal weight group 21.6 [2.2]/22.6 [1.9]. Authors concluded that "the lifestyle intervention program decreased EGWG, GWG, and offspring birth weight in pregnant women with normal, but not above normal, pre-pregnancy BMI, which was associated with increased physical activity and decreased carbohydrate intake".

Hui 2014 (Continued)

NCT00486629.

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Computer-generated randomisation table.
Allocation concealment (selection bias)	Low risk	Allocation by a staff member not involved in study design by sealed, numbered envelope.
Blinding of participants and personnel (performance bias) All outcomes	High risk	"the study staff were not blinded to the types of intervention."
Blinding of outcome assessment (detection bias) All outcomes	Low risk	Pregnancy and maternal weight outcomes were collected by student assistants without knowledge of assignment. (High risk for participant logbooks for exercise and diet).
Incomplete outcome data (attrition bias) All outcomes	Low risk	No withdrawals.
Selective reporting (reporting bias)	Unclear risk	Not able to determine.
Other bias	Low risk	None noted. Baseline characteristics comparable.

Jackson 2011

Methods	RCT, set in 5 prenatal care practices in the San Francisco Bay Area, USA, including 3 public hospitals, 2 academic practices, and a community hospital. 2006-2007.
Participants	327 women randomised. Inclusion criteria: English-speaking women 18 years or older and less than 26 weeks of gestation. Exclusion criteria: women who report smoking, alcohol use, drug use, or partner violence.
Interventions	Intervention group: (163 randomised) The Video Doctor: an interactive computer program including in-depth behavioural risk assessments and tailored counselling messages, and producing printed output for both the patient and clinician. An actor-portrayed Video Doctor appears and offers education on exercise, nutrition and weight gain based on principles of Motivational Interviewing. Dietary counselling focused on increasing intake of fruits and vegetables and whole grains, increasing healthful vs unhealthful fats and decreasing sugary foods. The Video Doctor emphasised dietary and exercise behaviour changes over weight gain. The Video Doctor programme required 10–15 mins to complete. After 4 weeks, participants received a brief “booster” Video Doctor counselling. Control group: (164 randomised) usual care. The usual care group did not interact with the Video Doctor and the program did not produce a Cueing Sheet or Educational Worksheet. Behavioural counselling for the usual care group was determined by the clinician.
Outcomes	Self-reported servings per day or week of healthful foods (e.g. fruits and vegetables) and unhealthful foods (e.g. sweets), and exercise duration and frequency, and weight gain above the IOM guidelines.

Jackson 2011 (Continued)

Notes	<p>Mean baseline age (intervention, control): 26.1 ± 5.8, 26.9 ± 6.2.</p> <p>Enrolment BMI (intervention, control): reported as % categories: overweight and obese women comprised 48% and 41% of intervention and control groups respectively.</p> <p>Gestation (intervention, control): 19.7 ± 5.5, 19.2 ± 6.0.</p>
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Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Randomisation by computer.
Allocation concealment (selection bias)	Low risk	Randomisation by computer (interactive computer programme intervention).
Blinding of participants and personnel (performance bias) All outcomes	Unclear risk	Participants would not have been blinded to group allocation.
Blinding of outcome assessment (detection bias) All outcomes	Unclear risk	It was not stated that staff or outcome assessors were blinded.
Incomplete outcome data (attrition bias) All outcomes	Low risk	6 women were excluded after randomisation: 3 due to insufficient English, 1 because of inaccurate gestational age, and 2 withdrew during the baseline assessment leaving 158 in the Video Doctor group and 163 in the usual care group. ITT analysis was performed for primary outcome (weight gain) for other outcomes 327 were randomised and 287 (88%) completed follow-up.
Selective reporting (reporting bias)	Unclear risk	Not able to determine as assessed from published study report.
Other bias	Unclear risk	There were no significant differences between the control and Video Doctor groups for any of the demographic variables listed except education. Results for weight gain were not fully reported by randomisation group. Results for mean weight gain of each group were reported without SDs.

Jeffries 2009

Methods	RCT, set in a tertiary obstetric hospital in Melbourne, Australia.
Participants	<p>Inclusion criteria: pregnant women at < 14 weeks' gestation.</p> <p>Exclusion criteria: age < 18 or > 45 years, type 1 or type 2 diabetes mellitus, multiple pregnancy, or non-English speaking.</p>
Interventions	<p>Intervention (n = 125): women allocated to the intervention group were given a personalised weight measurement card, advised of their optimal GWG (based on their BMI at the time of recruitment and the United States IOM guidelines, and instructed to record their weight at 16, 20, 24, 28, 30, 32 and 34 weeks' gestation.</p> <p>Control (n = 111): not given instructions about regular weight measurement.</p>

Jeffries 2009 (Continued)

Outcomes	<p>Weight gain above IOM guideline, mean weight gain from recruitment to follow-up at 36 weeks' gestation.</p> <p>SGA (< 10th centile), large-for-gestational age (> 90th centile), preterm (< 37 weeks), instrumental delivery, caesarean delivery, pre-eclampsias, neonatal hypoglycaemia, shoulder dystocia.</p> <p>Weight gain was weight difference between weight at about 36 weeks' gestation and weight at 1st antenatal appointment.</p>
Notes	<p>Gestation age at recruitment (intervention, control): 11.6, 11.4 weeks.</p> <p>BMI category, n (intervention, control):</p> <ul style="list-style-type: none"> • underweight (BMI ≤ 19.8): 5, 5; • normal (BMI > 19.8, ≤ 26.0): 75, 67; • overweight (BMI > 26, ≤ 29.0): 20, 18; • obese (BMI > 29.0): 25, 21.

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Using computer random number generation.
Allocation concealment (selection bias)	Low risk	Using opaque, sequentially numbered envelopes.
Blinding of participants and personnel (performance bias) All outcomes	Low risk	All participants were blinded to the purpose of the study.
Blinding of outcome assessment (detection bias) All outcomes	Unclear risk	Not described.
Incomplete outcome data (attrition bias) All outcomes	Low risk	Loss to follow-up, 23/148 in intervention group, 27/138 in control group. Similar reason of loss to follow-up in intervention and control groups.
Selective reporting (reporting bias)	Low risk	The outcomes reported as in the published protocol.
Other bias	Low risk	Baseline characteristics were similar.

Kieffer 2014

Methods	Parallel-arm RCT at community health centre in Detroit, USA from 2004 to 2006.
Participants	<p>General population, 278 randomised, all included in primary analysis.</p> <p>Inclusion criteria: pregnant Latinas were eligible if they were age 18 or older, South Detroit residents, and at less than 20 gestation weeks at eligibility screening.</p> <p>Exclusion criteria: see inclusion criteria.</p>

Kieffer 2014 (Continued)

Interventions	<p>Intervention group: a counselling intervention (MOMS intervention included home visits, group classes, related activities and social support from community health workers to influence eating and exercise, weight beliefs and behaviours) (n = 139) Intervention was administered over 11 weeks.</p> <p>Control group: routine care (n = 139).</p>
Outcomes	Dietary behaviour outcomes including sugar, fats, and fibre.
Notes	<p>Little usable data extracted from this report.</p> <p>Age (intervention, control): 27.3 [5.3]/27.1 [5.1].</p> <p>Enrolment gestational age < 20 weeks.</p> <p>Recruitment BMI: 24.2 [5.1]/24.7 [5].</p> <p>Authors concluded that "We confirmed the hypothesis that a community-planned CHW-led healthy lifestyle intervention could improve dietary behaviors of low-income Lantina women during pregnancy".</p>

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	A "statistician generated random allocation sequence in blocks of 40".
Allocation concealment (selection bias)	Low risk	"After baseline data collection, each women received...a sealed envelope containing her group assignment."
Blinding of participants and personnel (performance bias) All outcomes	Unclear risk	Blinding of participants was not feasible.
Blinding of outcome assessment (detection bias) All outcomes	Low risk	Data collected by trained interviewers who were blinded to group allocation.
Incomplete outcome data (attrition bias) All outcomes	Low risk	< 20% loss to follow-up. Data were available for 139/139 and 136/139 women in the intervention and control groups, respectively, for the primary analysis.
Selective reporting (reporting bias)	Unclear risk	Could not determine.
Other bias	Low risk	None noted. Baseline characteristics comparable.

Kong 2014

Methods	RCT at Low State University in USA (accrual dates not stated).
Participants	<p>Obese/overweight pregnant women, 42 randomised.</p> <p>Inclusion criteria: maternal age between 18 and 45 years, singleton pregnancy, nonsmoker, self-reported overweight (BMI \geq 25 kg/m²) or obese (BMI \geq 30 kg/m²) before pregnancy, no prior history of chronic diseases (including type 1 diabetes, cardiovascular disease, thyroid, or lung disorder), and no prior his-</p>

Kong 2014 (Continued)

tory of gestational diabetes. Only enrolled women with < 3 30-min episodes of physical activity in previous 6 months.

Exclusion criteria: see inclusion criteria.

Interventions	<p>Intervention group: exercise intervention (unsupervised walking program on treadmill or other setting for a minimum of 150 min/week) (n = 18).</p> <p>Control group: routine care (n = 19).</p>
Outcomes	Activity, weight gain, pregnancy risks and labour procedures, infant birth outcomes.
Notes	<p>Women were loaned treadmills for the study. Interventions continued at least to gestational week 35. Data reported separately for overweight (n = 18) and obese (n = 19) participants. Data were collected for 1 week periods at weeks 10-14 (baseline), weeks 17-19 (V2), weeks 27-29 (V3), and weeks 34-36 (V4).</p> <p>Age (obese group: intervention, control): 28.6 [5.3]/25.7 [4].</p> <p>Age (overweight group: intervention, control): 26.2 [2.6]/27.3 [3.6].</p> <p>Enrolment gestational age < 15 weeks.</p> <p>Recruitment BMI (obese group: intervention, control): 34.7 [4.6]/34.2 [3.6].</p> <p>Recruitment BMI (overweight group: intervention, control): 26.5 [1.2]/27.4 [1.4].</p> <p>Authors concluded that a "pilot, unsupervised walking intervention increased the moderate-intensity physical activity (MPA) of overweight and obese women during pregnancy" with "trend to more favourable maternal and birth outcomes" in the intervention group.</p>

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	"After the initial enrollment, participants were randomly assigned ...using a computer-based random number generator (Microsoft Excel 2010)."
Allocation concealment (selection bias)	Unclear risk	"All participants and research staff were blinded to the group allocation."
Blinding of participants and personnel (performance bias) All outcomes	High risk	Blinding of participants to intervention was not possible due to the nature of the intervention. Study coordinator not blinded.
Blinding of outcome assessment (detection bias) All outcomes	Unclear risk	Blinding of outcome assessor not described. Pregnancy outcome measures self-reported by participants via a postpartum questionnaire and may be subject to bias.
Incomplete outcome data (attrition bias) All outcomes	Unclear risk	9 withdrawals (19.6%, 5 in physical activity group and 4 in control group).
Selective reporting (reporting bias)	Low risk	All expected outcomes reported.
Other bias	Unclear risk	None noted. Baseline characteristics comparable.

Korpi-Hyovalti 2011

Methods	RCT, set in 2 hospitals in rural municipalities (Kauha-joki and Lapua) in Finland.
Participants	<p>60 women randomised.</p> <p>Inclusion criteria: women at high risk of gestational diabetes: women had 1 or more risk factors (BMI > 25 kg/m², previous history of GDM or birth of child > 4.5 kg, age > 40 years, family history of diabetes or the venous plasma glucose concentration after 12 hours fasting in the morning was 4.8-5.5 mmol/L and 2-hour OGTT plasma glucose < 7.8 mmol/L.</p> <p>Exclusion criteria: women who were diagnosed as having GDM in this study and women who had risk factors for GDM or whose fasting venous plasma glucose was 4.8-5.5 mmol/L but who for personal or professional reasons did not wish to participate in the trial.</p>
Interventions	<p>Intervention group: (n = 30) a lifestyle intervention; included diet counselling and exercise counselling. Dietary advice tailored to each woman individually on 6 occasions. Women were encouraged to eat a diet rich in vegetables, berries and fruits, and to use low-fat. Moderate-intensity physical exercise during pregnancy was encouraged, 6 sessions for exercise counselling</p> <p>Control group: close follow-up group (n = 30). All women were given general information on diet and physical activity to decrease the risk of GDM during pregnancy as part of routine care.</p>
Outcomes	Weight gain, GDM, birthweight.
Notes	<p>Age: 29.2 [5.4]/29.8 [5.4].</p> <p>Gestation at recruitment given as 8-12 weeks.</p> <p>Baseline BMI: 27.3 [6.0]/25.5 [3.4].</p>

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Women were randomly assigned to the lifestyle intervention group or to the close follow-up group by the study physician in the Central Hospital with the use of a computed randomisation list.
Allocation concealment (selection bias)	Unclear risk	Not stated.
Blinding of participants and personnel (performance bias) All outcomes	Unclear risk	Women were aware of group assignment although it was stated that the nurses scheduling study visits did not have access to the randomisation list. It is not clear what impact the lack of blinding would have on the outcomes measured.
Blinding of outcome assessment (detection bias) All outcomes	Unclear risk	Not described.
Incomplete outcome data (attrition bias) All outcomes	Unclear risk	60 women were randomised, 54 were followed up.
Selective reporting (reporting bias)	Unclear risk	Assessment from published study report.
Other bias	Unclear risk	There were no statistically significant differences in baseline measures between the lifestyle intervention and the close follow-up groups although

Korpi-Hyovalti 2011 (Continued)

women in the intervention group had slightly higher prepregnancy weight (mean 76.6 kg compared with 69.6 kg in controls).

Laitinen 2009

Methods	RCT, set in maternal welfare clinics in the city of Turku and neighbouring areas in south-west Finland.
Participants	<p>Women were eligible for participation if they were less than 17 weeks' gestation and had no metabolic or chronic diseases such as diabetes.</p> <p>Participants were Caucasian.</p>
Interventions	<p>At 1st trimester 256 pregnant women were allocated to 3 groups: modification of dietary intake according to current recommendations with probiotics or placebo and a control group receiving placebo only.</p> <ol style="list-style-type: none"> 1. Control group, (placebo) (n = 85). 2. Intervention group 1 (n = 86) (diet counselling and placebo). 3. Intervention group 2 (n = 85) (diet counselling and probiotics), probiotic capsules containing <i>Lactobacillus rhamnosus</i> GG and <i>Bifidobacterium lactis</i> Bb12. <p>Dietary counselling given by a dietitian at each study visit aimed to modify dietary intake to conform with that currently recommended, particular attention being paid to the quality of dietary fat</p> <p>Study visits took place 3 times during pregnancy at 13.9 (SD 1.6), 23.8 (SD 1.4) and 33.9 (SD 1.4) weeks of gestation and at 1, 6 and 12 months postpartum.</p>
Outcomes	<p>Weight gain, energy intake, dietary fibre intake at 3rd trimester of pregnancy.</p> <p>Weight gain was calculated by subtracting self-reported prepregnancy weight from that recorded at a prenatal visit or at hospital within 1 week before delivery.</p>
Notes	<p>Age (intervention 1, intervention 2, control): 30.1 ± 5.2, 29.7 ± 4.1, 30.2 ± 5.0.</p> <p>Enrolment BMI NR.</p>

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Women were randomly assigned to 3 study groups according to computer-generated block randomisation.
Allocation concealment (selection bias)	Low risk	Using sealed envelopes. At the 1st study visit the envelopes were opened. The random allocation sequence was thus concealed until interventions were assigned.
Blinding of participants and personnel (performance bias) All outcomes	Low risk	Probiotics/placebo were double-blind in the intervention groups but single blind in the control group.
Blinding of outcome assessment (detection bias) All outcomes	Unclear risk	Not described.
Incomplete outcome data (attrition bias)	Low risk	No loss to follow-up (to delivery).

Laitinen 2009 (Continued)

All outcomes

Selective reporting (reporting bias)	Low risk	The outcomes reported as in the published protocol.
Other bias	Low risk	No other bias apparent.

Leiferman 2011

Methods	RCT conducted by the Colorado School of Public Health, Denver, USA.	
Participants	Pregnant women. Inclusion/exclusion criteria not described.	
Interventions	My Baby My Move (MBMM) was an 8-week community-based program that involved both didactic and experiential components. Peer leaders delivered the program.	
Outcomes	Sparse information and no data were available on this trial.	
Notes	<p>Conference abstract only with no usable data.</p> <p>Authors concluded that "These findings suggest that implementing community-based interventions to increase antenatal PA are well received and show promise in ultimately changing PA behaviour".</p> <p>Full report is pending (personal communication).</p> <p>Nodine 2011 is a substudy of 29 women from this study that examined the effect of exercise on sleep parameters.</p>	

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Insufficient information on which to base judgement.
Allocation concealment (selection bias)	Unclear risk	Insufficient information on which to base judgement.
Blinding of participants and personnel (performance bias) All outcomes	Unclear risk	Insufficient information on which to base judgement.
Blinding of outcome assessment (detection bias) All outcomes	Unclear risk	Insufficient information on which to base judgement.
Incomplete outcome data (attrition bias) All outcomes	Unclear risk	Insufficient information on which to base judgement.
Selective reporting (reporting bias)	Unclear risk	Insufficient information on which to base judgement.
Other bias	Unclear risk	Insufficient information on which to base judgement.

Louie 2011

Methods	Parallel-arm RCT conducted in Australia.
Participants	99 randomised, 92 analysed. Inclusion criteria: women with GDM diagnosed by GTT at 20-32 weeks' gestation and singleton pregnancy.
Interventions	Dietary intervention: low GI diet (n = 47) vs conventional high-fibre, moderate GI diet (n = 45). Intervention included 3 face-to-face visits with the study dietician.
Outcomes	Birthweight, LGA, SGA, caesarean section, macrosomia, GWG.
Notes	Age (intervention, control): 34 [4.1]/32.4 [4.5]. Enrolment gestational age: 26.1 [4]/26 [4.3]. Prepregnancy BMI: 23.9 [4.4]24.1 [5.7]. Authors concluded that "In intensively monitored women with GDM, an LGI diet and a conventional HF diet produce similar pregnancy outcomes". They suggested that because the intervention began after the 29th week gestation this may have attributed to the lack of difference.

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Central randomisation by "computer-generated numbers, stratified by BMI (BMI < 30 vs ≥ 30) and weeks of gestation (< 28 vs ≥ 28)".
Allocation concealment (selection bias)	Low risk	"The allocation sequence was unpredictable and concealed from the recruiter."
Blinding of participants and personnel (performance bias) All outcomes	Low risk	Not described.
Blinding of outcome assessment (detection bias) All outcomes	Low risk	"A biostatistician blinded to the diet allocation performed the statistical analyses."
Incomplete outcome data (attrition bias) All outcomes	Low risk	"Four women delivered prematurely and three women withdrew after first dietary instruction."
Selective reporting (reporting bias)	Low risk	All pre-specified outcomes reported.
Other bias	Low risk	Baseline characteristics comparable.

Luoto 2011

Methods	Cluster-RCT, set in primary healthcare centres in 14 municipalities in Pirkanmaa region in south-western Finland.
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Luoto 2011 (Continued)

Participants	<p>Recruitment 2007-8.</p> <p>Inclusion criteria: pregnant women at 8–12 weeks' gestation at high risk of developing gestational diabetes; BMI ≥ 25 kg/m² based on measured height and self-reported prepregnancy weight; GDM or any signs of glucose intolerance or newborn's macrosomia (≥ 4500 g) in any earlier pregnancy; type 1 or 2 diabetes in 1st- or 2nd-degree relatives; or age ≥ 40 years.</p> <p>Exclusion criteria: at least 1 of the 3 baseline (8–12 weeks' gestation) OGTT measurements was abnormal (fasting blood glucose ≥ 5.3 mmol/L, 10.0 mmol/L at 1 hr, and 8.6 mmol/L at 2 hr); prepregnancy type 1 or 2 diabetes; inability to speak Finnish; age <18 yr; multiple pregnancy; physical restriction preventing physical activity; substance abuse; treatment or clinical history of psychiatric illness.</p>
Interventions	<p>Intervention group: (7 municipalities) Individual counselling on physical activity and diet and weight gain. At the 1st visit the recommendations for GWG were discussed and an appropriate weight gain graph was selected to guide the participant in monitoring her weight gain. The primary physical activity counselling was implemented at 8–12 weeks' gestation and the primary dietary counselling session at 16–18 weeks' gestation. Physical activity counselling was enhanced at 4, and diet counselling at 3 subsequent visits.</p> <p>Control group: (7 municipalities) usual care group received no counselling beyond usual care, which included some dietary counselling (partly on different topics) and follow-up of gestational weight, but little physical activity counselling.</p>
Outcomes	<p>Incidence of GDM as assessed by OGTT (maternal outcome) and newborns' birthweight adjusted for gestational age, maternal weight gain and the need for insulin treatment during pregnancy, changes in physical activity and diet (intake of total fat, saturated and polyunsaturated fatty acids, saccharose, and fibre).</p>
Notes	

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	The unit of randomisation was municipality. In the randomisation process, participating municipalities were 1st pair-wise matched. 14 municipalities were then randomised by computer.
Allocation concealment (selection bias)	Low risk	Cluster-randomised trial with computer randomisation.
Blinding of participants and personnel (performance bias) All outcomes	High risk	Unblinded.
Blinding of outcome assessment (detection bias) All outcomes	Unclear risk	Women in the intervention group were provided with notebooks to record diet and activity, women in the control group were not; this may have affected recall and may have introduced bias. It was not clear whether staff collecting outcome data were blind to group assignment.
Incomplete outcome data (attrition bias) All outcomes	High risk	No loss of clusters (14 clusters were randomised and all were included in the analysis). 343 women in the intervention and 297 in the usual care group agreed to participate in the trial. However, 81 (23.6%) of the participants in intervention group and 93 (31.3%) of the participants in the usual care group had an abnormal OGTT result at baseline and were thus excluded. The final number of participants in the analyses was 219 (89.0% of participants receiving allocated intervention) in the intervention group and 180 (91.8% of partici-

Luoto 2011 (Continued)

		pants receiving allocated intervention) in the usual care group. However about 40% of eligible participants of each group were followed up.
Selective reporting (reporting bias)	Unclear risk	Assessment from published study reports. Analysis appropriate for clusters. There was adjustment of data for clustering and various cluster, clinic and individual level differences at baseline.
Other bias	Unclear risk	Baseline characteristics of each group were similar, except that women in the intervention group had higher education than in the usual care group.

Magee 1990

Methods	RCT, set in prenatal care at the University of Washington Obstetrics Clinics.
Participants	Pregnant women with obesity (prepregnancy weight > 120% of ideal body weight) and diagnosed with gestational diabetes, recruited at 28 weeks' gestation.
Interventions	<p>All women were hospitalised for 2-week duration in the metabolic ward.</p> <p>Intervention: calorie-restricted (n = 7): during the 1st week, the women consumed normal diet with 2400 kcal/day; 50% CHO, 30% fat and 20% protein with 11 g of total dietary fibre per 500 kcal. During the 2nd week, the women were placed on 1200 kcal/day diet. This reduction was accomplished by decreasing portion sizes without changing other features of diet.</p> <p>Control (n = 5): during the 1st week, the women consumed identical diet as the intervention group; 2400 kcal/day, and continued on the same diet (2400 kcal/day) during the 2nd week.</p>
Outcomes	<p>Metabolic indices: fasting plasma glucose, OGTT, insulin, triglyceride, free fatty acids, glycerol, β-hydroxybutyrate, and urine ketones.</p> <p>We have not included outcome data from this hospital inpatient study in the analyses in the review.</p>
Notes	Age (calorie-restricted, control): 30 \pm 4, 36 \pm 5 years.

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	No information provided.
Allocation concealment (selection bias)	Unclear risk	No information provided.
Blinding of participants and personnel (performance bias) All outcomes	Unclear risk	No information provided.
Blinding of outcome assessment (detection bias) All outcomes	Unclear risk	No information provided.
Incomplete outcome data (attrition bias) All outcomes	Unclear risk	No information provided.

Magee 1990 (Continued)

Selective reporting (reporting bias)	Unclear risk	Could not determine.
Other bias	Unclear risk	No information provided.

Marcinkevage 2012

Methods	RCT in a large urban hospital in the USA.	
Participants	High risk (obese and overweight), 55 randomised, 36 analysed so far (ongoing). Inclusion criteria: overweight and obese 'minority' women receiving prenatal care. Gestation at recruitment: 14.4 +2.8. Exclusion criteria: see inclusion criteria.	
Interventions	Intervention group: lifestyle intervention (monthly behavioural counselling meeting focused on reducing sedentary behaviour and increasing levels of physical activity) (n = 17). Control group: routine care (n = 19).	
Outcomes	Physical activity, GWG, glucose values.	
Notes	Abstract only with no usable data. Preliminary analysis shows decrease in median(range) total activity in both groups from first visit to mid-pregnancy. Reduction in sedentary behaviour from first trimester to mid-pregnancy in intervention but not regular group. Median(range) GWG at mid-pregnancy is similar for both groups. At mid-pregnancy lower fasting and 30 min glucose values in intervention vs regular care. Preliminary data demonstrate the feasibility of modifying lifestyle during early pregnancy in underserved black women. Authors concluded that "Preliminary data demonstrate the feasibility of modifying lifestyle during early pregnancy in underserved black women".	

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Not described. "randomly assigned".
Allocation concealment (selection bias)	Unclear risk	Not described.
Blinding of participants and personnel (performance bias) All outcomes	Unclear risk	Not described.
Blinding of outcome assessment (detection bias) All outcomes	Unclear risk	Not described.
Incomplete outcome data (attrition bias) All outcomes	Unclear risk	Insufficient information.

Marcinkevage 2012 (Continued)

Selective reporting (reporting bias)	Unclear risk	Insufficient information.
Other bias	Unclear risk	Insufficient information.

Moses 2009

Methods	Randomised controlled trial, set in the city of Wollongong, New South Wales, Australia.	
Participants	<p>Inclusion criteria: pregnant women, age 18–40 years (inclusive), singleton pregnancy, no previous GDM, nonsmoker, diagnosis of GDM and seen for the 1st dietary visit between 28 and 32 weeks of gestation, and ability to follow the protocol requirements.</p> <p>Exclusion criteria: any condition or medication that could affect glucose levels and unwillingness to follow the prescribed diet.</p>	
Interventions	<p>63 women were randomly assigned to receive 1 of 2 different diets, low-GI diet (n = 31) or higher-GI diet (n = 32). Both diets were compatible with the recommended nutritional intake in pregnancy. The CHO intake was designed to achieve a minimum of 175 g/day with only the recommended choice of CHO foods varying. The dietary advice by dietitian was individualised with specific mention of the energy and nutrient balance to achieve normal weight gain during the 3rd trimester.</p> <p>The low-glycaemic diet: based on previously verified low-GI food, including pasta, grain breads, and unprocessed breakfast cereals with a high fibre content. Women were specifically asked to avoid consuming white bread, processed commercial breakfast cereals, potatoes, and some rice varieties.</p> <p>The higher-glycaemic diet: a diet with a high-fibre and low-sugar content, with no specific mention of the GI. Potatoes, whole wheat bread, and specific high-fibre, moderate-to-high-GI breakfast cereals were recommended.</p>	
Outcomes	Induction of labour, method of delivery, LGA baby (> 90th centile), SGA baby (< 10th centile).	
Notes	<p>Age (LGI, HGI): 30.8 + 0.7, 31.3 + 0.8.</p> <p>Gestational age at entry to study (LGI, HGI): 30.3 + 0.2 weeks, LGI 29.9 + 0.2 weeks.</p> <p>BMI at enrolment (LGI, HGI): 32.0, 32.8 kg/m².</p>	

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Women were randomly assigned using permuted blocks of unequal size with the list generated using STATA (version 7.0).
Allocation concealment (selection bias)	Unclear risk	Not stated.
Blinding of participants and personnel (performance bias) All outcomes	Unclear risk	<p>The physician caring for the women was blinded. Study dietitians were not blinded to dietary assignment but were aware of the need for impartiality and equivalent treatment</p> <p>Participants were impossible to blind to the GI concept, as it is widely known and discussed in the lay press.</p>
Blinding of outcome assessment (detection bias)	Unclear risk	Not described.

Moses 2009 (Continued)

All outcomes

Incomplete outcome data (attrition bias) All outcomes	Low risk	No dropout apparent.
Selective reporting (reporting bias)	Unclear risk	Could not determine.
Other bias	Low risk	There were no significant differences in the baseline characteristics of the 2 groups.

Moses 2014

Methods	Parallel-arm RCT conducted in Australia from Feb 2010 to Sept 2012.	
Participants	691 randomised, 576 analysed. Inclusion: healthy pregnant women at 12 to 16 weeks' gestation who agree to be randomised. Exclusion: women with pregestational diabetes; multiple birth; assisted reproduction; special diet or referred to a dietitian for other reasons.	
Interventions	A low glycaemic diet (n = 354) or a conventional healthy diet (n = 337) from 12 to 16 weeks' gestation for the remainder of pregnancy.	
Outcomes	Primary outcomes: prevalence of LGA at birth (more than 90th centile); prevalence of childhood obesity as determined by BMI. Secondary outcomes: prevalence of gestational diabetes; ponderal index; prevalence of SGA; GWG.	
Notes	Age (intervention, control): 29.9 [0.3]/29.9 [0.3]. Enrolment gestational age: 16.5 [0.1]/16.2 [0.1]. Pregnancy BMI: 24.3 [0.3]/24.7 [0.3]. Outcomes were assessed at baseline, 28 weeks and 34 weeks. Authors concluded that "A low-intensity dietary intervention with an LGI diet compared with an HE diet in pregnancy did not result in any significant differences in birth weight, fetal percentile, or PI. In conclusion, the outcome of this study was neutral. Infants of women instructed to consume LGI CHO foods during pregnancy were of normal size and had a similar PI to those of infants of women who received conventional HE advice".	

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	"Randomly assigned."
Allocation concealment (selection bias)	Unclear risk	"Randomly assigned."
Blinding of participants and personnel (performance bias)	High risk	"Study personnel were not blinded to the dietary assignment but were aware of the need for impartiality and equivalent treatment. Obstetric care providers

Moses 2014 (Continued)

All outcomes		were not specifically blinded to the study allocation but were also not informed."
Blinding of outcome assessment (detection bias) All outcomes	Low risk	Not described.
Incomplete outcome data (attrition bias) All outcomes	Low risk	Dropout < 20%. In the low GI group, 58 women were later excluded (27 women had developed GD). In the HE group, 57 women were later excluded (28 women had developed GD).
Selective reporting (reporting bias)	Low risk	Prespecified outcomes reported.
Other bias	Low risk	None noted. Baseline characteristics comparable.

Mujisindi 2014

Methods	RCT (setting not mentioned) in USA (accrual dates NR).	
Participants	High risk (obese and overweight), 79 randomised. Inclusion criteria: overweight and obese 'minority' women receiving prenatal care. Exclusion criteria: see inclusion criteria.	
Interventions	Intervention group: lifestyle intervention (behaviour counselling with 5 dietary/nutrition consultations during pregnancy and at 3 months postpartum, food records, pedometers and logs, pregnancy activity questionnaire and food frequency questionnaire) (n = ?). Control group: routine care (n = ?).	
Outcomes	Primary outcome was GWG and postpartum weight retention rates. Secondary outcomes included obstetric, delivery and neonatal outcomes.	
Notes	Abstract only with no usable data. Obese women enrolled in a structured nutrition program during pregnancy and in the postpartum period had similar GWG and postpartum weight retention to women in standard care. There was no difference in demographic data, parity, smoking status and socioeconomic status. When comparing the PEN vs STD groups, there was no difference in mean GWG at 20 weeks, 24, 30 and 36 weeks. Return to study entry weight was compared between the groups at 3 and 6 months. There was no difference between the groups at either time (P = 0.21 and 0.18 respectively). Authors concluded that "Obese women enrolled in a structured nutrition program during pregnancy and in the postpartum period had similar gestational weight gain and postpartum weight retention as women in standard care".	

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Not described. "Randomly assigned."
Allocation concealment (selection bias)	Unclear risk	Not described.

Mujisindi 2014 (Continued)

Blinding of participants and personnel (performance bias) All outcomes	Unclear risk	Not described.
Blinding of outcome assessment (detection bias) All outcomes	Unclear risk	Not described.
Incomplete outcome data (attrition bias) All outcomes	Unclear risk	Insufficient information.
Selective reporting (reporting bias)	Unclear risk	Insufficient information.
Other bias	Unclear risk	Insufficient information.

Murtezani 2014

Methods	A parallel arm RCT conducted in the Republic of Kosovo. Accrual dates not given.	
Participants	72 pregnant women randomised, 63 analysed.	
Interventions	<p>Intervention (n = 30) involved an exercise training program that started in the second trimester and was continued until the end of pregnancy. Each session consisted of 40-45 min of aerobic and strength exercise. Individuals were supervised by certified aerobic-instructors, and each session included a maximum of 10 participants. Intensity was moderate to vigorous; supine postures and Valsalva manoeuvres were avoided.</p> <p>Controls had routine care (n = 33).</p>	
Outcomes	GWG, neonatal weight, Apgars, macrosomia.	
Notes	<p>The participants were examined twice during the study period. The first visit was between 14-20 weeks of gestation (baseline visit) and the second at week 36-38 (after the intervention).</p> <p>Recruitment age: 26.9 [4.7]/25.7 [5.1].</p> <p>Recruitment gestation: 18.9 [1.8]/ 18.3 [1.4].</p> <p>Prepregnancy BMI: 23 [2.6]/ 22.4 [2.2].</p> <p>"Supervised aerobic and strength conditioning exercise performed over the second and third trimesterdoes not have a negative impact on the newborn's size and health."</p> <p>Reported gestational weight, not weight gain.</p>	

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Random assignment procedure was performed using random numbers generated by a computer program.
Allocation concealment (selection bias)	Unclear risk	Not described.

Murtezani 2014 (Continued)

Blinding of participants and personnel (performance bias) All outcomes	Unclear risk	Report states 'single blind' but details not provided.
Blinding of outcome assessment (detection bias) All outcomes	Unclear risk	Report states 'single blind' but details not provided.
Incomplete outcome data (attrition bias) All outcomes	Unclear risk	9 participants (4 from the control group and 5 from the intervention group) withdrew after randomisation for medical and personal reasons: hypertension (n = 2), vascular disease (n = 1), intrauterine growth restriction (n = 1), amniotic-fluid leakage (n = 2), premature birth (n = 1), injured n = 1) and unknown (n = 1). It was not stated from which group these withdrawals occurred.
Selective reporting (reporting bias)	High risk	Women with hypertension, preterm birth and amniotic fluid leakage were excluded after randomisation, yet these are potential side effects of vigorous exercise in pregnancy.
Other bias	High risk	Baseline characteristics were similar for study groups. Women with hypertension, preterm birth and amniotic fluid leakage were excluded after randomisation, yet these are potential side effects of vigorous exercise in pregnancy and needed to be reported.

Nascimento 2012

Methods	RCT conducted at an antenatal outpatient clinic in Brazil from August 2008 to March 2010.	
Participants	High risk. Overweight or obese, 82 randomised. Inclusion criteria: pregnant women ≥ 18 yrs, pre-gestational BMI ≥ 26 kg/m ² , gestational age 14-24 weeks. Exclusion criteria: multiple pregnancy, exercising regularly, and conditions that contraindicate exercise, such as cervical incompetence, severe arterial hypertension, diabetes with vascular disease and risk of abortion.	
Interventions	Intervention group: supervised exercise program (n = 40). Intervention consisted of an exercise program guided by a trained physical therapist in weekly classes with light to moderate intensity exercise for 40 mins. It also included home exercise counselling which was to be performed 5 times per week (consisting of a sequence of 22 exercises or walking). Control group: routine prenatal care program (n = 42).	
Outcomes	Primary outcomes were GWG and excessive weight gain. Secondary outcomes were increased arterial blood pressure, perinatal outcomes and QoL (WHOQOL).	
Notes	Outcomes measured at baseline and 36 weeks. Delivery data were collected from medical records. Age (intervention, control): 29.7 [6.8]/30.9 [5.9]. Enrolment gestational age (intervention, control): 14.3 [4.5]/13.6 [3.5]. Prepregnancy BMI: 34.8 [6.6]/36.4 [6.9]. Slight baseline imbalances noted as 8/40 vs 15/42 were diabetic and 15/40 vs 22/42 were hypertensive in exercise and control groups, respectively, at baseline.	

Nascimento 2012 (Continued)

Authors concluded that "The exercise programme was not associated with control of gestational weight gain in our sample as a whole, but was beneficial for lower gestational weight gain in overweight women. Exercise was not associated with adverse perinatal outcomes and did not affect variation in arterial blood pressure or the perception of QoL".

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	"Randomised to the groups using the SAS statistical program (SAS Institute, Cary, NC, USA), which generated a list of random numbers based on a uniform distribution."
Allocation concealment (selection bias)	Low risk	"The sequence was randomly distributed in opaque envelopes, which were sealed and sequentially numbered. Each participant received a sequence number corresponding to a sealed envelope."
Blinding of participants and personnel (performance bias) All outcomes	Unclear risk	Not described.
Blinding of outcome assessment (detection bias) All outcomes	Unclear risk	Not described.
Incomplete outcome data (attrition bias) All outcomes	Unclear risk	1 woman in each group withdrew. For neonatal weight outcome, missing data were > 20% but similar numbers missing in each group. Authors indicate that this was because some women delivered at other hospitals.
Selective reporting (reporting bias)	Low risk	Prespecified outcomes reported.
Other bias	Unclear risk	Baseline imbalances noted as 8/40 vs 15/42 were diabetic and 15/40 vs 22/42 were hypertensive in exercise and control groups, respectively, at baseline. Also, the control group had a greater proportion of obese women. This could affect some outcomes (e.g. LGA, GWG) in favour of the intervention.

Oostdam 2012

Methods	RCT at hospitals and midwifery practices in The Netherlands from January 2007 to January 2011.
Participants	<p>High risk. Overweight or obese, 121 randomised, 101 analysed.</p> <p>Inclusion criteria: pregnant women who were overweight or obese and at risk for GDM. AND had at least 1 of the 3 following characteristics: (1) history of macrosomia. (2) history of GDM; or (3) first-grade relative with Type 2 diabetes.</p> <p>Exclusion criteria: recruitment after 20 weeks of gestation; age under 18 years; non-Dutch speaker; having been diagnosed with GDM before randomisation; hypertension; alcohol abuse; drug abuse; use of any medication that affects insulin secretion or insulin sensitivity; serious pulmonary, cardiac, hepatic, or renal impairment; malignant disease; and serious mental or physical impairment.</p>
Interventions	<p>Intervention group: exercise intervention (2 sessions of aerobic and strengthening exercises per week; each exercise session lasted for 60 mins) (n = 62).</p> <p>Control group: routine care (n = 59).</p>

Oostdam 2012 (Continued)

Outcomes	Maternal outcome measures were fasting blood glucose (mmol/L, fasting insulin (pmol/L) and HbA1c (%), body weight (kg), BMI (kg/m ²), and daily physical activity (min/week). Offspring outcome measures were birthweight and fetal growth.
Notes	Outcomes assessed at baseline, 24 and 32 weeks. Age (intervention, control): 30.8 [5.2]/30.1 [4.5]. Enrolment gestational age was 15 weeks. Prepregnancy BMI: 33 [3.7]/33.9 [5.6]. Authors concluded that exercise intervention "had no effects on fasting blood glucose, insulin sensitivity, and birthweight, most probably because of low compliance".

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Block randomisation, stratified by hospital.
Allocation concealment (selection bias)	Low risk	"Women were recruited by midwives and gynaecologists who were unaware of the allocation of other women, with no risk of compromising allocation concealment."
Blinding of participants and personnel (performance bias) All outcomes	High risk	"By the nature of the intervention the researcher and research assistant could not be blinded for allocation after randomisation."
Blinding of outcome assessment (detection bias) All outcomes	Low risk	"All outcome measures were assessed by independent examiners, unaware of group allocation."
Incomplete outcome data (attrition bias) All outcomes	High risk	High dropout rates, especially at 32 weeks (19/62 [31%] did not respond in intervention group and 12/59 [20%] did not respond in control group). For GWG outcome dropout rate was 31% overall.
Selective reporting (reporting bias)	Low risk	Prespecified outcomes reported.
Other bias	High risk	Poor adherence to the intervention - "only a small proportion (16.3%) of the women in our intervention group attended at least half of the training sessions". Follow-up weight gain data were collected at 32 weeks (much earlier than most other included studies).

Petrella 2013

Methods	RCT in Italy (setting and accrual dates NR).
Participants	High risk. Overweight or obese. 61 randomised. Inclusion criteria: women with BMI > 25 at 1st trimester, > 18 years with singleton pregnancy at 12 weeks' gestation.

Petrella 2013 (Continued)

Exclusion criteria: women with twin pregnancy, chronic disorders, GDM in previous pregnancy, smoking, previous surgery, women who engaged in regular physical activity, or used dietary supplements or herbal products known to affect body weight were excluded.

Interventions	<p>Intervention group: lifestyle intervention involving a caloric restricted low GI diet (1500 kcal/day) and prescribed moderate-intensity exercise 30 min/day, 3 times per week. Pedometers were to be worn (n = 33).</p> <p>Control group: routine care with a nutritional brochure about health eating (n = 28).</p>
Outcomes	GDM, GWG, hypertension, and preterm delivery.
Notes	<p>Recruitment age: 31 [4.2]/32.4 [5.9].</p> <p>Gestational age: first trimester.</p> <p>Recruitment BMI: 32.1 [5]/ 32.9 [6.2].</p> <p>Authors concluded that "A constant physical activity and a change toward healthy eating improves nutrients intake, prevents excessive weight gain and avoids the maternal unfavorable outcomes associated with overweight/obese women".</p>

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Computer-generated randomisation in blocks of 3.
Allocation concealment (selection bias)	Low risk	"Study randomization is numbered and sealed in white envelopes. Randomization occurs in consecutive order at time of the first visit."
Blinding of participants and personnel (performance bias) All outcomes	High risk	"Due to study design, both gynecologist and dietitian know the allocation of the patient."
Blinding of outcome assessment (detection bias) All outcomes	High risk	Assessor knew the allocation.
Incomplete outcome data (attrition bias) All outcomes	Low risk	Only 2 women in the control group withdrew.
Selective reporting (reporting bias)	Low risk	Prespecified outcomes reported.
Other bias	Low risk	Baseline characteristics similar.

Petrov Fieril 2014

Methods	RCT conducted at 2 ANCs in Gothenburg, Sweden with recruitment from Feb 2006 to Nov 2006 and Sept 2008 to April 2009.
Participants	92 pregnant women randomised, 72 analysed.

Petrov Fieril 2014 (Continued)

Included if singleton pregnancy < 14 weeks' gestation, no medical or obstetric complications, ability to understand Swedish.

Excluded if contraindications to exercise in pregnancy.

Interventions	Intervention group received supervised resistance exercise twice a week, with light barbells and weight plates in a group setting, performed at an activity level equivalent to within moderate-to-vigorous between weeks 14 to 25 gestation, and was self-adjusted (n = 51). In addition, walking, cycling, water-gymnastics, Pilates, yoga and home exercises that included pelvic floor training were recommended. Controls received a generalised exercise recommendation, a home-based training program and a telephone (n = 41).
Outcomes	Health-related quality of life, physical strength, pain, weight, blood pressure, functional status, activity level and perinatal data.
Notes	<p>Little usable review data (birthweight only).</p> <p>Age (intervention, control): 30.8 [3.6]/30.6 [3.4].</p> <p>Enrolment gestational age: 13 weeks.</p> <p>Prepregnancy BMI: 22.6 [2.5]/23 [2.6].</p> <p>Authors concluded that "supervised, moderate-to vigorous resistance exercise does not jeopardize the health status of healthy pregnant women or the fetus".</p>

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	"participants were randomly assigned to either the intervention group or the control group (allocation ratio 1:1)", however the group sizes were significantly different (51 vs 41, respectively).
Allocation concealment (selection bias)	Low risk	"The research coordinator performed the randomization by using opaque sealed envelopes, which were randomly picked out before the meeting with each participant."
Blinding of participants and personnel (performance bias) All outcomes	High risk	Not blinded.
Blinding of outcome assessment (detection bias) All outcomes	Low risk	"All data were collected at a primary health care location by an investigator who was blinded to" group allocation.
Incomplete outcome data (attrition bias) All outcomes	High risk	25% and 18% of participants dropped out of the intervention and control groups, respectively.
Selective reporting (reporting bias)	Unclear risk	Protocol not seen. GWG and EGWG NR.
Other bias	Low risk	Baseline characteristics were similar in study groups.

Phelan 2011

Methods	RCT, 2 arms with individual randomisation stratified by prepregnancy weight, set in 6 obstetric offices in Providence, Rhode Island, USA from 2006 to 2008.
Participants	<p>401 women randomised.</p> <p>Inclusion criteria: gestational age between 10 and 16 weeks, BMI between 19.8 and 40, nonsmoking, adults (aged > 18 yr), fluency in English, access to a telephone, and a singleton pregnancy.</p> <p>Exclusion criteria: major health or psychiatric diseases, weight loss during pregnancy, or a history of ≥ 3 miscarriages.</p>
Interventions	<p>Intervention group: standard care plus a behavioural lifestyle intervention. The Fit for Delivery intervention included a face-to-face visit with an interventionist at the onset of treatment who discussed appropriate weight gains during pregnancy, physical activity (30 min of walking most days of the week), and calorie goals (20 kcal/kg); emphasis was placed on decreasing high fat foods, increasing physical activity, and daily self-monitoring of eating, exercise, and weight. Body-weight scales, food records, and pedometers were provided to promote adherence to daily self-monitoring. Automated postcards that prompted healthy eating and exercise habits were mailed weekly. In addition, after each clinic visit, women were sent personalised graphs of their weight gains with feedback. All women in the intervention received 3 brief (i.e. 10–15 min) supportive phone calls from the dietitian during the intervention. Women who were over- or under weight-gain guidelines during any 1 month interval received additional brief, supportive phone calls (2 calls/month) that provided structured meal plans, and specific goals until weight gains returned to appropriate amounts.</p> <p>Control group: routine care. Women received standard nutrition counselling provided by physicians, nurses, nutritionists, and counsellors. As part of routine care women were weighed by nurses at each clinical visit; weight graphs were not provided.</p>
Outcomes	Excessive weight gain, low weight gain, preterm birth, pre-eclampsia or eclampsia, caesarean delivery rate, high birthweight, low birthweight, maternal weight retention.
Notes	<p>Baseline age (intervention, control): 28.8 ± 5.2, 28.6 ± 5.2.</p> <p>Baseline BMI (intervention, control): 26.48 ± 5.9, 26.32 ± 5.6.</p> <p>Enrolment gestation (intervention, control): 13.5 ± 1.8, 13.6 ± 1.8.</p>

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Randomisation was computer-generated in randomly varying block sizes and stratified by clinic and BMI category.
Allocation concealment (selection bias)	Low risk	Allocation was concealed in opaque envelopes prepared by the study statistician.
Blinding of participants and personnel (performance bias) All outcomes	Unclear risk	Unblinded.
Blinding of outcome assessment (detection bias) All outcomes	Low risk	In the abstract it was stated that outcome assessors were blinded.
Incomplete outcome data (attrition bias) All outcomes	Low risk	Lost to follow-up 34 in the standard care group, 36 in the intervention group. Exclusions: 18 in the standard care group, 25 in the intervention group.

Phelan 2011 (Continued)

401 participants were randomly assigned into the intervention (n = 201) and control groups (n = 200), included in 6 month postpartum analysis; 182 control, 176 intervention.

ITT analysis was performed assuming that those lost to follow-up were treatment failures. It was reported that this revealed almost identical results as for those completing the study (data not shown).

Selective reporting (reporting bias)	Unclear risk	Assessment from published study report.
Other bias	Unclear risk	The 2 study groups did not significantly differ on key baseline measures (sample stratified).

Pinzon 2012

Methods	RCT conducted in Colombia with recruitment from March 2008 to November 2009.
Participants	<p>General population. 64 women randomised.</p> <p>Inclusion criteria: nulliparous women in gestational week 16-20 with live fetus and normal pregnancy.</p> <p>Exclusion criteria: history of high BP, chronic illness, persistent bleeding after 12 weeks' gestation, poorly-controlled thyroid disease, placenta praevia, incompetent cervix, oligohydramnios, miscarriage in previous 12 months.</p>
Interventions	<p>Intervention group: exercise intervention (n = 33) involved a supervised exercise program 3 times a week for 12 weeks. Exercise sessions involved walking (10 min) aerobic exercise (30 min), stretching (10 min) and relaxation exercise (10 min).</p> <p>Control group: usual activities (n = 31).</p>
Outcomes	Fitness (VO ₂ max, BP, heart rate at rest, and other parameters) changes in blood lipids, insulin sensitivity (HOMA-IR) and body composition (fat-free mass, body fat, skinfold thickness and muscular area), maternal weight, birthweight, neonatal outcomes.
Notes	<p>Age (intervention, control): 19.2 [2.6]/19.5 [3.4].</p> <p>Enrolment gestational age: 17.5 [3.4]/17 [4.5].</p> <p>Recruitment BMI: 21.4 [2.4]/22.4 [3.8].</p> <p>"Regular aerobic exercise improves endothelium-dependent vasodilation in pregnancy." (Ramirez-velez 2011) "At the end of the 3-month program, there was no difference in the change in blood lipids. Triglycerides and VLDL were significantly lower in the experimental group. The experimental group showed lower values of body fat and skinfold thicknesses than did the control group, but these differentials were non-significant." (Pinzon 2012) There was no significant difference between groups regarding maternal weight gain during pregnancy.</p> <p>Authors concluded that "The potential public health benefits of exercise are too great and this study supports existing guidelines indicating that latina women may begin or maintain an exercise program during pregnancy".</p>

Risk of bias

Bias	Authors' judgement	Support for judgement
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Pinzon 2012 (Continued)

Random sequence generation (selection bias)	Low risk	"computer-generated randomisation list."
Allocation concealment (selection bias)	Low risk	Sequentially numbered sealed opaque envelopes. "The treatment allocation system was set up so that the researcher in charge of randomly assigning participants to each group did not know in advance which treatment the participant was going to receive."
Blinding of participants and personnel (performance bias) All outcomes	Low risk	"double-blind" "research assistants were blinded to the group assignment of the subjects and were in charge of the prenatal care of the women". "Due to the nature of the study, it was not possible to blind the women participating."
Blinding of outcome assessment (detection bias) All outcomes	Low risk	"all study measurements were done by a person blinded to the distribution of the patients."
Incomplete outcome data (attrition bias) All outcomes	High risk	14 women withdrew early (22%; 9 in study and 5 in control arm) therefore 50/64 women assessed for fitness outcomes. Weight and pregnancy outcome data were only available for 35/64 women (55%; 18 in study and 17 in control group).
Selective reporting (reporting bias)	Unclear risk	Unable to comment as study protocol not seen.
Other bias	Low risk	None noted. Adherence was 75%. Baseline characteristics were similar.

Pollak 2014

Methods	Pilot RCT with ratio 2:1, conducted in 2 antenatal clinics in USA in 2012.
Participants	<p>35 overweight and obese women randomised.</p> <p>Included if 18 years or older, English-speaking, registered for prenatal care at participating clinics, pre-pregnancy BMI of 25–40, 12–21 weeks' gestation, and having a cell phone with an unlimited texting plan for the next 5 months.</p> <p>Excluded if pre-existing diabetes, limited mobility or inability to walk, impaired cognition or mental health with inability to provide consent.</p>
Interventions	<p>SMS texting intervention (n = 22) targeting weight-related behaviours including increasing daily steps to 10000, avoiding sweetened drinks, eating 5 fruit and veg per day, and eliminating fast food intake. Tests were sent 3 times per week and women were asked to text back their self-monitored weight measurement.</p> <p>Control intervention (n = 11) was a general 'text4baby' intervention with general information about pregnancy with few tests related to healthy eating or physical activity.</p> <p>Women were asked to wear a pedometer.</p>
Outcomes	<p>Weight at 40 weeks, eating habit scores, physical activity scores.</p> <p>Follow-up surveys were conducted at approximately 22 and 32 weeks' gestation and women weighed. In addition, weights were obtained from clinical records from baseline and delivery.</p>

Pollak 2014 (Continued)

Notes	<p>No usable data for this review. The main results were that mean weight gain in the intervention group was estimated to be 6 pounds less than the control group at 40 weeks' gestation for women who completed the intervention (n = 23).</p> <p>Mean age: 29 vs 32 years.</p> <p>Gestation at recruitment: 16 vs 17 weeks.</p> <p>Pre-pregnancy BMI: 29 vs 28 kg/m².</p> <p>Investigators concluded that "SMS texting is a promising vehicle for behavior change among pregnant women".</p>
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Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	"randomized eligible women in a 2:1 fashion."
Allocation concealment (selection bias)	Unclear risk	Not described.
Blinding of participants and personnel (performance bias) All outcomes	Unclear risk	Not described.
Blinding of outcome assessment (detection bias) All outcomes	Unclear risk	Not described.
Incomplete outcome data (attrition bias) All outcomes	Low risk	10 women withdrew from the study; however, their weight data from clinical records were included (ITT analysis). 2 others miscarried and were excluded.
Selective reporting (reporting bias)	Unclear risk	Protocol not seen but no usable (extractable) outcome data were provided in the report.
Other bias	Low risk	Baseline characteristics were similar.

Polley 2002

Methods	RCT, set in an obstetric clinic for low-income women at a hospital in Pittsburgh, PA, USA.
Participants	<p>Inclusion criteria: pregnant women before 20 weeks of gestation. (Women were recruited in to 4 cells; normal and overweight, black and white.)</p> <p>Exclusion criteria: underweight women, younger than 18 years, 1st prenatal visit > 12 weeks' gestation, high-risk pregnancy (i.e. drug abuse, chronic health problems, previous complications during pregnancy, current multiple gestation).</p>
Interventions	Intervention (n = 57): the intervention was provided at regular scheduled clinic visits by staff with training in nutrition or clinical psychology. Education about weight gain, healthy eating, and exercise and individual graphs of their weight gain.

Polley 2002 (Continued)

Shortly after recruitment, written and oral information were given in the following area: appropriate weight gain, exercise, healthy eating. Newsletters prompting healthy eating and exercise habits were mailed bi-weekly. After each clinic visit, women were sent a personalised graph of their weight gain.

Those exceeding weight gain goals were given additional individualised nutrition and behavioural counselling using the format listed; a stepped care approach.

Control (n = 53): usual care: standard nutrition counselling provided by the physicians, nurses, nutritionists and WIC counsellors. This counselling emphasised a well-balanced dietary intake and advice to take a multivitamin/iron supplement.

Outcomes	<p>Excessive weight gain, total weight gain, low weight gain.</p> <p>Low birthweight infants, macrosomia infants, preterm delivery, caesarean delivery, pre-eclampsia, weight retention at 4 weeks' postpartum.</p> <p>Total weight gain was based on self-reported prepregnancy weight and weight at last clinic visit prior to delivery.</p>
Notes	<p>Excessive weight gain categorised as above the IOM recommendations.</p> <p>Low weight gain categorised as below the IOM recommendations.</p> <p>IOM recommends a weight gain of 6.8-11.3 kg for overweight women (BMI of 26-29) and a weight gain of 6.8 kg (with no specified upper limit) for obese women (BMI > 29).</p> <p>Age of participants 25.5 ± 4.8.</p> <p>Gestational age at recruitment (intervention, control): 14.7 ± 3.1 weeks.</p> <p>BMI category, n (intervention, control):</p> <ul style="list-style-type: none"> • normal weight (BMI 19.8-26): 30, 31; • overweight (BMI > 26): 27, 22.

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Women were randomly assigned to the standard care control group or to the intervention.
Allocation concealment (selection bias)	Unclear risk	No information provided.
Blinding of participants and personnel (performance bias) All outcomes	Unclear risk	No information provided.
Blinding of outcome assessment (detection bias) All outcomes	Unclear risk	No information provided.
Incomplete outcome data (attrition bias) All outcomes	Low risk	Using ITT approach. Loss to follow-up < 10%.
Selective reporting (reporting bias)	Unclear risk	Could not determine.

Polley 2002 (Continued)

Other bias	Unclear risk	Refusal rates were higher among black women (28/74 refused) than among white (16/90 refused), and higher in overweight black women than in any of the other 3 weight-by-race categories.
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Poston 2013

Methods	A pilot RCT conducted at multiple tertiary and university hospitals in the UK with recruitment from March 2010 to May 2013. (UPBEAT study).	
Participants	183 randomised, 154 analysed. Inclusion criteria: BMI ≥ 30 kg/m ² and singleton pregnancy; gestational age > 15 weeks and < 17 weeks' gestation. Exclusion criteria: unable or unwilling to give written informed consent; gestation < 15 weeks and > 17 weeks, pre-existing diabetes, pre-existing hypertension (treated), pre-existing renal disease, multiple pregnancies; systemic lupus erythematosus antiphospholipid syndrome, sickle cell disease, thalassaemia, coeliac disease, currently prescribed metformin, thyroid disease or current psychosis.	
Interventions	Intervention group: a lifestyle intervention (diet plus exercise) (n = 94) involving 1 1-to-1 session with a health trainer and then weekly group sessions for 8 consecutive weeks from 19 weeks' gestation. Sessions delivered by health trainers involved diet and exercise advice informed by psychological models of health behaviour. Dietary advice focused on increased consumption of foods with a low dietary GI, and reduction of saturated fats. Physical activity advice encouraged women to increase daily walking activity at moderate intensity level, setting goals monitored by a pedometer. Women also received a DVD of a pregnancy specific exercise regimen. Control group: routine care (n = 89).	
Outcomes	Primary outcome: GDM. Others were GWG, macrosomia, LGA, dietary and exercise parameters, anxiety and depression.	
Notes	Age (intervention, control): 30.4 [5.7]/30.7 [4.9]. Enrolment gestational age was 16 weeks. Recruitment BMI: 36.5 [4.7]/36.1 [4.8].	

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	"Randomisation was performed online" "balanced by minimisation for maternal age, centre, ethnicity, parity and BMI."
Allocation concealment (selection bias)	Low risk	"randomised treatment was allocated automatically" by online randomisation program.
Blinding of participants and personnel (performance bias) All outcomes	Unclear risk	Not described.
Blinding of outcome assessment (detection bias) All outcomes	Unclear risk	Not described.

Poston 2013 (Continued)

Incomplete outcome data (attrition bias) All outcomes	Low risk	14 women (15.7%) dropped out of the control arm, and 15 lost to follow-up in the intervention group (15.8%).
Selective reporting (reporting bias)	Unclear risk	Prespecified outcomes reported, except for GWG. ITT analysis.
Other bias	Low risk	Baseline characteristics were comparable.

Price 2012

Methods	RCT at local obstetric practices in Austin, Texas, in USA from July 2006 to March 2010.	
Participants	General population, 91 randomised, 62 analysed. Inclusion criteria: sedentary women 12-14 weeks' gestation; viable singleton pregnancy at 12-14 weeks by reasonable dates and/or ultrasound; body mass index (BMI) less than 39 kg/m ² . Exclusion criteria: no aerobic exercise more than once per week for at least the past 6 months; chronic heart or lung disease; poorly controlled diabetes, hypertension, epilepsy, or hyperthyroidism; severe anaemia no orthopedic limitations; and history of premature delivery, infant delivered for SGA, or unexplained fetal death.	
Interventions	Intervention group: exercise intervention (n = 43). Exercise intervention involved a program of supervised aerobic training (45-60 mins, 4 days a week). Control group: sedentary women (n = 48). "Control subjects were told not to exercise."	
Outcomes	Cardiorespiratory fitness. Strength, flexibility, and discomfort. Pregnancy complications, delivery data, postpartum recovery.	
Notes	Outcomes assessed at 5 points: 12-14 weeks, 18-20 weeks, 24-26 weeks, 30-32 weeks, and 6-8 weeks postpartum. Age (intervention, control): 30.5 [5]/27.6 [7.3] (P = 0.08). Enrolment gestational age was at 12-14 weeks. Prepregnancy BMI: 26.6 [3.1]/28.7 [5.4] (P = 0.042). "Previously sedentary women who began exercising at 12-14 weeks had improved fitness and delivery outcomes." Authors concluded that "Compared with women who remained sedentary, active women improved aerobic fitness and muscular strength, delivered comparable size infants with significantly fewer cesarean deliveries, and recovered faster postpartum, at least related to the lower incidence of cesarean section. Active women developed no gestational hypertension and reported no injuries related to the exercise regimen".	

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	"Randomly assigned."

Price 2012 (Continued)

Allocation concealment (selection bias)	Low risk	"Subjects were randomized using numbered, opaque envelopes containing an equal number of group assignments prepared by the study statistician."
Blinding of participants and personnel (performance bias) All outcomes	High risk	Participants and personnel not blinded.
Blinding of outcome assessment (detection bias) All outcomes	High risk	Not blinded. "Author kept a log of attendance" and seemed to perform the fitness assessments.
Incomplete outcome data (attrition bias) All outcomes	High risk	12/43 (28%) and 17/48 (35%) dropped out in the intervention and control groups, respectively. Reasons for drop outs in intervention group were logistics (9) and other reasons (3). Reasons in control group were immediate withdrawal due to wanting to exercise (5), and later withdrawal due to wanting to exercise (3) and logistics (9).
Selective reporting (reporting bias)	Unclear risk	Mean weight gain (12.4 kg vs 10.5 kg in intervention and control groups, respectively) was NR with standard deviations or denominators so these data were not usable in our meta-analysis.
Other bias	High risk	Baseline BMI was significantly lower in the intervention group and loss to follow-up was high. Also, "control subjects were told not to exercise because it would blur the distinction between the groups". This contributed to high drop out rates in the control group and may make results less generalisable by enforcing no exercise. This study design seems ethically flawed.

Quinlivan 2011

Methods	RCT set in the maternity service of a public general hospital serving a socio-economically disadvantaged area in Melbourne, Australia.	
Participants	132 randomised. Inclusion criteria: pregnant with a fetus with no known anomalies, spoke English, did not intend to relinquish their infant, did not have a multiple gestation, were able to attend hospital for antenatal care and were overweight (BMI 25–29.9) or obese (BMI > 29.9). Exclusion criteria: not described.	
Interventions	Intervention group: a 4-step multidisciplinary protocol of antenatal care which had the following 4 criteria: (i) continuity of care provider; (ii) weighing on arrival; (iii) brief dietary intervention by a food technologist at every antenatal visit; and (iv) psychological assessment. Women attended special study clinics. Control group: routine care (with access to high-risk clinics if medically indicated).	
Outcomes	Weight gain, preterm delivery.	
Notes		
Risk of bias		
Bias	Authors' judgement	Support for judgement

Quinlivan 2011 (Continued)

Random sequence generation (selection bias)	Low risk	Randomisation to the intervention or control groups occurred using computer-generated sequence.
Allocation concealment (selection bias)	Low risk	Numbered sealed opaque envelopes, stratified by category (overweight or obese;16), which were only opened by the midwife after each woman's enrolment was completed.
Blinding of participants and personnel (performance bias) All outcomes	Unclear risk	Not described.
Blinding of outcome assessment (detection bias) All outcomes	Low risk	Outcome data for mother and infant were audited by a nurse independent of clinical care pathways and blinded to randomisation status.
Incomplete outcome data (attrition bias) All outcomes	Low risk	132 randomised, 124 analysed (8 excluded from analysis (4 of each group).
Selective reporting (reporting bias)	Unclear risk	Assessment from published study report.
Other bias	Unclear risk	There were no significant differences in terms of antenatal, demographic and health behaviour variables between intervention and control groups. Women in the intervention group attended special study clinics; these clinics may have been different from standard clinics in more ways than the intended study interventions (although it was stated that care was standard apart from the 4 stage intervention).

Rae 2000

Methods	RCT, set in the Diabetes Service, King Edward Memorial Hospital for Women, Perth, Western Australia	
Participants	<p>Inclusion criteria: gestation < 35 weeks and 6 days, > 110% of ideal body weight for height (adjusted for expected pregnancy weight gain and using a BMI of 25 as equal to 100% ideal body weight), OGTT with fasting plasma glucose > 5.4 mmol/L and/or 2-hour plasma glucose > 7.9 mmol/L.</p> <p>Exclusion criteria: not stated.</p>	
Interventions	<p>Intervention (n = 63): the intervention comprised instruction in a moderately energy restricted diabetic diet providing between 1590-1776 kcal (70% RDA).</p> <p>Control (n = 54): the control group were instructed in a diabetic diet which was not energy restricted, providing approximately 2010-2220 kcal a day.</p>	
Outcomes	<p>Weight gain, pre-eclampsias, induction of labour, caesarean delivery, shoulder dystocia, birthweight > 4000 g, birthweight > 90th centile, assisted delivery.</p> <p>Weight gain was calculated as the difference between prepregnancy weight and delivery weight.</p>	
Notes	<p>Age (intervention, control) 30.2, 30.6 years.</p> <p>Gestation at diagnosis(intervention, control) 28.1 ± 5.8, 28.3 ± 4.6 weeks.</p> <p>BMI at diagnosis (intervention, control) 37.9 ± 0.7, 38.0 ± 0.7 kg/m².</p>	

Rae 2000 (Continued)

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Not stated.
Allocation concealment (selection bias)	Low risk	Women were allocated at random using opaque numbered envelopes.
Blinding of participants and personnel (performance bias) All outcomes	Low risk	Both participants and the Diabetes Service staff were blinded to the allocation to diet group. Medical staff were blinded to the group allocation of each participant.
Blinding of outcome assessment (detection bias) All outcomes	Unclear risk	Not described.
Incomplete outcome data (attrition bias) All outcomes	Low risk	Loss to follow-up 6.4% (8), 4 for each group.
Selective reporting (reporting bias)	Unclear risk	Could not be determined.
Other bias	Low risk	The groups were similar in level of education, employment, racial distribution, and alcohol and cigarette consumption. There were no significant differences at enrolment in weight, or energy expenditure.

Rauh 2013

Methods	Cluster-RCT, open-label at 8 gynaecological practices in Germany from February 2010 to August 2012.
Participants	General population. 250. Inclusion criteria: older than 18, 1 live fetus, < 18 weeks' gestation, BMI ≥ 18.5 kg/m ² , and able to speak sufficient German. Exclusion criteria: if they had any condition preventing physical activity, such as cervical incompetence, placenta praevia, or persistent bleeding. Prepregnancy diabetes or uncontrolled diseases that may affect weight development like thyroid dysfunction, or psychiatric diseases.
Interventions	Intervention group: lifestyle counselling (n = 167) Intervention consisted of 2 individually delivered counselling sessions focusing on diet, physical activity and weight self-monitoring, delivered at the 20th (60 min) and 30th week (30 min) by trained researchers. Control group: routine care (n = 83).
Outcomes	The primary outcome was the proportion of pregnant women exceeding weight gain recommendations of the IOM. The secondary outcome variables were maternal weight retention at 4 months postpartum and short-term obstetric and neonatal outcomes.
Notes	Age (intervention, control): 32.2 [4.4]/30.8 [4.9].

Rauh 2013 (Continued)

Enrolment gestational age: 9 (8-11)/7 (6-8).

Prepregnancy BMI: 21.7 (19.9-23.7)/22.8 (20.6-26.6).

We were unable to adjust reported data for clustering and baseline differences, therefore we did not pool these data.

The study report gave adjusted MD for GWG of -1.7 kg (-3.0 to -0.3) in favour of the intervention, and for excessive GWG an adjusted OR of 0.5 (0.3 to 0.9).

Authors concluded that "Lifestyle counselling given to pregnant women reduced the proportion of pregnancies with excessive GWG without increasing suboptimal weight gain, and may exert favourable effects on postpartum weight retention".

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	"Computer generated allocation table." "Gynaecological practices were randomised (rather than individuals)."
Allocation concealment (selection bias)	Low risk	"Randomisation was performed by a researcher not involved in the study design thereby preventing allocation bias."
Blinding of participants and personnel (performance bias) All outcomes	High risk	Blinding not possible due to "the nature of the study".
Blinding of outcome assessment (detection bias) All outcomes	High risk	Blinding not possible for study staff due to "the nature of the study".
Incomplete outcome data (attrition bias) All outcomes	Unclear risk	No loss of clusters. 15/167 women in the intervention group and 9/83 control group women were lost to follow-up. Women in the intervention group dropped out for personal reasons (5), miscarriage or late-term abortion (3), complications of pregnancy (3) and preterm delivery (4). Control women dropped out because of personal reasons (1), moved away (1), unable to contact (2) and preterm delivery (5).
Selective reporting (reporting bias)	Unclear risk	Protocol not seen. Appropriate analysis methods used for clusters. Results were adjusted for age and prepregnancy BMI, which was higher in the control group. ITT not stated.
Other bias	High risk	<p>"During recruitment it turned out that it was easier to recruit women for the intervention group than for the control group, yielding a 2:1 ratio", instead of 1:1. Practices differed in size with 227 vs 129 women were eligible for the intervention and control groups, respectively.</p> <p>Baseline characteristics differed significantly with regard to pregravid BMI (P = 0.003) and BMI at booking (P = 0.008), with a higher proportion of women in the control group considered obese or overweight (16.2% vs 31.4%; P = 0.009). Mean age was younger and gestational age at booking was significantly earlier in the intervention clusters. Although results were adjusted for BMI, age and clustering, there may also have been other (unknown) differences between the women in these groups.</p> <p>Preterm birth and pregnancy complications NR as outcomes and these women were excluded from the analysis.</p>

Renault 2014

Methods	3-arm RCT at 1 hospital in Hvidovre in Denmark from March 2009 to March 2012.
Participants	<p>High risk. Obese. 425 randomised. 389 analysed.</p> <p>Inclusion criteria: pregnant women with a prepregnancy BMI of 30 kg/m² or greater. Age older than 18 years, a singleton pregnancy, and a normal scan in weeks 11-14, gestational age at inclusion of less than 16 weeks, and an ability to read and speak Danish.</p> <p>Exclusion criteria: multiple pregnancy, pregestational diabetes, or other serious diseases limiting their level of physical activity, previous bariatric surgery, or alcohol or drug abuse.</p>
Interventions	<p>Comparison of 3 groups.</p> <p>Intervention groups: intervention 1: physical activity and diet (n = 130); intervention 2: physical activity only (n = 125). The physical activity intervention included encouragement of increase physical activity, aiming at a daily step count of 11,000, monitored by pedometer assessment on 7 consecutive days, every 4 weeks. Dietary intervention included follow-up on a hypocaloric Mediterranean-style diet. Instruction was given by a dietician every 2 weeks with alternating outpatient visits and phone calls, including weight measurement, encouragement and correcting advice</p> <p>Control group: routine care (n = 134).</p>
Outcomes	<p>Primary outcome: GWG.</p> <p>Secondary outcomes: complications of pregnancy and delivery and neonatal outcome.</p>
Notes	<p>Age (intervention 1, intervention 2, control): 31.2 [4.4]/ 30.9 [4.4]/31.3 [4.2].</p> <p>Enrolment gestational age was 11-14 weeks.</p> <p>Prepregnancy BMI: 34.4 [4.2]/34.1 [4.4]/33.7 [3.5].</p> <p>GWG was calculated from the 36-37 week weight minus prepregnancy self-reported weight and was reported as median (range) so could not be included in the review meta-analysis for this outcome. GWG in the physical activity plus diet group was 8.6 kg (-9.6 to 34.1) vs 9.4 kg in the physical activity group (-4.4 to 28.2) vs 10.9 kg in the control group (-4.4 to 28.7) (P = 0.024). 1 woman in the physical activity group had a placental abruption and stillbirth.</p> <p>Authors concluded that "No significant difference was found between the 2 intervention groups. Physical activity intervention assessed by pedometer with or without dietary follow-up reduced GWG compared with controls in obese pregnant women. The pedometer intervention is an inexpensive methods of increasing daily physical activity and can easily be implemented into daily clinical practice".</p>

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	"The randomization was stratified according to parity to ensure equal distribution of primiparous in the 3 groups."
Allocation concealment (selection bias)	Low risk	"Web allocation by an independent organization properly concealed the procedure."
Blinding of participants and personnel (performance bias) All outcomes	High risk	Blinding not possible due to the nature of the study.

Renault 2014 (Continued)

Blinding of outcome assessment (detection bias) All outcomes	Unclear risk	Assessor blinding not described.
Incomplete outcome data (attrition bias) All outcomes	Low risk	Low attrition rates for most outcomes. However, physical activity scores had > 20% missing data and we considered these data high risk.
Selective reporting (reporting bias)	Unclear risk	Could not determine.
Other bias	Low risk	Baseline characteristics were comparable. Good compliance.

Rhodes 2010

Methods	RCT (pilot study), set in Beth Israel Deaconess Medical Center, Boston, MA, and Children's Hospital Boston, Boston, MA, USA.	
Participants	<p>Inclusion criteria: pregnant women with prepregnancy or 1st trimester BMI equal to or greater than 25 kg/m² and less than 45 kg/m², singleton pregnancy, willing to consume the diets for duration of pregnancy, participant to be at week 28 or less of pregnancy at baseline visit.</p> <p>Exclusion criteria: smoking during pregnancy, major medical illness (e.g. diabetes mellitus, hypertension, thyroid disease), taking prescription medication known to affect body weight, alcohol consumption during pregnancy, intention to deliver infants in the environment outside of Beth Israel Deaconess Medical Center, Boston, high level of physical activity.</p>	
Interventions	<p>Intervention group 1: nutrition education, dietary counselling, and a low-GI diet.</p> <p>Intervention group 2: nutrition education, dietary counselling, and a low-fat diet.</p>	
Outcomes	<p>Maternal outcome: weight change.</p> <p>Infant outcome: macrosomia, large-for-gestational age, caesarean delivery.</p>	
Notes	<p>Age (intervention, control): 33.7 [3.9]/33.2 [3.7].</p> <p>Enrolment gestational age: 19.8 (5)/19.6 (4.3).</p> <p>Prepregnancy BMI (intervention, control): 32.1(4.6)/ 31.2 (3.1).</p>	

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Randomly "permuted blocks of 2 and 4 preventing anticipation of future assignments.
Allocation concealment (selection bias)	Low risk	Separate random assignment envelopes for each stratum. Random assignment envelopes were prepared by the hospital clinical trials unit.
Blinding of participants and personnel (performance bias) All outcomes	Low risk	Formal blinding of participants was not possible, although participants were not informed of their group assignments. The following staff were blinded to group assignment: obstetricians who provided clinical care to women; nurses who measured maternal body weight and blood pressure, collected and processed maternal blood samples, and analysed urinalyses; labour and deliv-

Rhodes 2010 (Continued)

		ery room nurses who obtained birthweight; laboratory staff who analysed maternal blood; and staff who performed data entry.
Blinding of outcome assessment (detection bias) All outcomes	Unclear risk	Staff who performed maternal body composition analysis, 24-h dietary recalls, and infant anthropometric measurements “were predominantly, but not always”, blinded due to logistical considerations.
Incomplete outcome data (attrition bias) All outcomes	Unclear risk	46 women were randomised and infant outcomes were available for 45. There was some loss to follow-up among women with outcome data at 36 weeks available for 38. Reasons for loss were explained and loss was reasonably balanced across groups. It was stated that analysis was by randomisation group irrespective of whether or not women received the intended intervention.
Selective reporting (reporting bias)	Unclear risk	Assessment from published study report.
Other bias	Low risk	Baseline characteristics of participants did not differ between intervention groups.

ROLO 2012

Methods	RCT conducted at a maternity hospital in Ireland with recruitment from January 2007 to January 2011.	
Participants	800 randomised, 759 analysed. Inclusion criteria: secundigravid women whose first baby was macrosomic (birthweight > 4.0 kg). Exclusion criteria: underlying medical disorders, previous history of gestational diabetes, those on any drugs, and those unable to give full informed consent, age less than 18 years, gestation greater than 18 weeks, and multiple pregnancy.	
Interventions	Low GI dietary intervention (n = 394) involving 1 dietary education session lasting 2 hours in groups of 2-6 women with a dietitian at baseline. Follow-up reinforcement sessions were held at 28 and 34 weeks' gestation. Women received written resources about low GI foods. Control group: routine care (n = 406).	
Outcomes	Primary outcome: birthweight. Secondary outcomes: GWG, maternal GI and dietary intake.	
Notes	GTT was done at 28 weeks' gestation. Women completed food diaries. Other outcomes were recorded on delivery. Age (intervention, control): 32 [4.2]/32 [4.2]. Enrolment gestational age: 13 [2.3]/12.9 [2.2]. Recruitment BMI: 26.8 [5.1]/26.8 [4.8]. Glucose challenge test at 28 weeks showed significantly less women in the intervention group vs control group with glucose intolerance defined as GCT > 7.8 mmol/L (54/350 [15%] vs 79/371 [21%]).	

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	"The research midwife did the randomisation by using computer generated allocations in a ratio of one to one."

ROLO 2012 (Continued)

Allocation concealment (selection bias)	Low risk	"sealed opaque envelopes."
Blinding of participants and personnel (performance bias) All outcomes	Unclear risk	Not described.
Blinding of outcome assessment (detection bias) All outcomes	Unclear risk	Not described.
Incomplete outcome data (attrition bias) All outcomes	Low risk	Low attrition rates for most outcomes.
Selective reporting (reporting bias)	Unclear risk	Excluded women who did not receive allocated intervention (i.e. per protocol analysis).
Other bias	Low risk	Baseline characteristics were comparable. Good compliance.

Ronnberg 2014

Methods	Registered, open-label, parallel assignment RCT conducted in Sweden. ID NCT00451425.
Participants	General population: 445 women randomised, 374 analysed. Included if > 18 years old, Swedish speaking, BMI ≥ 19, gestation < 16 weeks, and healthy. Excluded if history of eating disorders or history of previous growth restricted child.
Interventions	Intervention group: a motivational exercise intervention that included a personalised weight graph, GWG monitoring at each antenatal visit, and prescribed exercise to be at a "moderate level of exertion for approximately 30 min/day". The intervention was administered at routine antenatal visits by midwives. Control group: standard care. All women received basic dietary advice according to Swedish national guidelines.
Outcomes	GWG (1990 IOM guidelines), weight retention up to 1ne year, fetal and maternal complications in pregnancy and during delivery, infant birthweight and infant weight up to 1 year of age.
Notes	Age: 29.9 [4.5]/ 29.9 [4.8]. Enrolment gestational age: 10.7 vs 9.7 weeks. 72% normal weight women, 28% overweight or obese.

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	"computer-generated in blocks of variable sizes between 4 and 8."

Ronnberg 2014 (Continued)

Allocation concealment (selection bias)	Low risk	"Sealed, opaque, sequentially numbered envelopes were kept by administrative personnel not related to the study." A research assistant opened the next envelope and informed the midwife telephonically of each group allocation.
Blinding of participants and personnel (performance bias) All outcomes	High risk	Not blinded.
Blinding of outcome assessment (detection bias) All outcomes	Unclear risk	Not described.
Incomplete outcome data (attrition bias) All outcomes	Low risk	Loss to follow-up was 8% in the intervention group and 11% in the control group. ITT analysis performed.
Selective reporting (reporting bias)	Unclear risk	Only GWG outcomes reported. Other maternal and fetal outcomes were stated as having "no significant difference between groups". Unpublished data requested.
Other bias	Unclear risk	Gestational age at recruitment was statistically significantly different (10.7 weeks vs 9.7 weeks, for intervention and control groups, respectively).

Ruchat 2012

Methods	RCT of 2 interventions compared with historical control in Canada.	
Participants	<p>General population, 73 recruited, 49 analysed.</p> <p>Inclusion criteria: normal weight women with singleton pregnancies between 16 and 20 weeks' gestation.</p> <p>Exclusion criteria: specific exclusion criteria included the following: maternal age < 18 years or > 40 years, smoking, multiple pregnancy, presence of chronic disease, or other contraindications to exercise.</p>	
Interventions	<p>2 lifestyle interventions vs an historical control.</p> <p>Intervention groups: interventions were moderate-intensity exercise plus diet (n = 26), vs low-intensity exercise plus diet (n = 23). The low-intensity exercise intervention consisted of a walking program that corresponded with 30% HRR (oxygen consumption reserve) whereas the moderate-intensity program corresponded with a 70% HRR. The exercise was performed 3 to 4 times per week, with 1 session per week supervised. Participants wore an HR monitor to ensure they were exercising within the predetermined target HR zone.</p> <p>Control group: control group were 45 normal weight women with singleton pregnancies who did not participate in a structured exercise program.</p> <p>All participants received a diet plan based on a modified diabetic diet.</p>	
Outcomes	GWG, maternal weight retention 2 months postpartum, infant birthweight.	
Notes	<p>We only included data from the randomised participants, i.e. the low intensity intervention vs moderate intensity intervention. As control group was not randomised, we did not use these data.</p> <p>Age (intervention 1, intervention 2): 30.4 [4.5]/ 31 [3.8].</p>	

Ruchat 2012 (Continued)

Enrolment gestational age: 17 [1.5]/17.5 [1.5].

Prepregnancy BMI: 21.7 [1.9]/22.1 [1.7].

Diet outcomes were collected between 34 and 36 weeks' gestation. Women were weighed weekly in the laboratory. Delivery and newborn data were obtained from medical records and complication during delivery were obtained from maternal recall within 6-18 hours after delivery.

Authors concluded that "Results suggest that a prenatal nutrition exercise program regardless of exercise intensity, reduced excessive GWG and decreased weight retention at 2 months postpartum in women of normal weight before pregnancy".

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	"All the participants were randomised using a block procedure with four subjects per block."
Allocation concealment (selection bias)	Unclear risk	Not described.
Blinding of participants and personnel (performance bias) All outcomes	Unclear risk	Not described.
Blinding of outcome assessment (detection bias) All outcomes	Unclear risk	Assessor blinding not described. Exercise and diet logs were recorded by the participants at home.
Incomplete outcome data (attrition bias) All outcomes	High risk	Only 49 participants (67%) out of 73 completed the study. Even if 1 excludes the 7 women who "decided to withdraw after the peak exercise test" (before randomisation), withdrawal is still > 20%. Similar numbers withdrawn from both groups.
Selective reporting (reporting bias)	Unclear risk	Could not determine.
Other bias	High risk	Control group was historical, not randomised; therefore, these data were not used in the review. See Potential biases in the review process .

Ruiz 2013

Methods	RCT at 3 primary care hospitals in Madrid, Spain, from September 2007-January 2011.
Participants	<p>General population, 962 randomised and analysed.</p> <p>Inclusion criteria: women who were sedentary (not exercising for > 20 mins on > 3 days a week), with singleton and uncomplicated gestations, not at high risk of preterm delivery (i.e.. previous preterm birth) and not participating in any other trial were able to participate in this study.</p> <p>Exclusion criteria: women with any obstetric contraindication to exercise were not eligible to participate.</p>
Interventions	Intervention group: exercise intervention (n = 481). The intervention included light- to moderate-intensity aerobic and resistance exercises performed 3 days a week (50-55 mins per session) from 9 weeks to weeks 38-39. Exercise sessions included 8-10 participants.

Ruiz 2013 (Continued)

Control group: routine care (n = 481).

Outcomes	Primary outcome: GWG. Secondary outcomes: Maternal and fetal outcomes, including birthweight, gestational age, type of delivery (caesarean, etc), Apgar scores, childbirth, gestational diabetes and hypertension.
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Notes	<p>Age (intervention, control): 31.6 [4]/ 31.9 [4].</p> <p>Enrolment gestational age was 5-6 weeks.</p> <p>Prepregnancy BMI: 23.7 [3.9]/23.5 [4.2].</p> <p>GWG was calculated from measured weight at last visit minus weight at first prenatal visit. Other outcomes were obtained from hospital records after delivery.</p> <p>Authors concluded that "Supervised exercise of light to moderate intensity can be used to prevent excessive gestational weight gain, especially in normal weight women. The effects seemed to be more pronounced in normal weight women...".</p>
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Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	"Computer generated."
Allocation concealment (selection bias)	Unclear risk	Not described.
Blinding of participants and personnel (performance bias) All outcomes	Unclear risk	Not described.
Blinding of outcome assessment (detection bias) All outcomes	Unclear risk	Not described.
Incomplete outcome data (attrition bias) All outcomes	Unclear risk	14% attrition overall. 68 women in the control arm were lost to follow-up because of threat of premature delivery (n = 11), persistent bleeding (n = 9), a move to another hospital (n = 20), or miscellaneous personal reasons (n = 28). 70 women in the intervention arm were lost to follow-up due to threat of premature delivery (n = 14), persistent bleeding (n = 7), a move to another hospital (n = 25), or miscellaneous personal reasons (n = 24). No protocol deviations.
Selective reporting (reporting bias)	Low risk	Expected outcomes reported.
Other bias	Low risk	None noted. Baseline characteristics were comparable.

Santos 2005

Methods	Randomised clinical trial, set in a referral centre prenatal clinic in Porto Alegre, Brazil, during the period 2000-2002.
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Santos 2005 (Continued)

Participants	<p>Inclusion criteria: healthy, nonsmoking pregnant women, aged 20 years or more, of gestational age less than 20 weeks, having a BMI between 26 and 31 kg/m² (corresponding to a prepregnancy BMI of 25-30 kg/m²) (overweight), and without diabetes or hypertension.</p> <p>Exclusion criteria: not stated.</p>
Interventions	<p>Intervention (n = 37): the intervention consisted of a program of supervised physical exercise of 60 mins duration, performed 3 times per week for 12 weeks. Each session consisted of 5-10 mins of warm up, 30 mins of heart rate-monitored aerobic activity, 10-15 mins of exercise involving upper and lower limbs, and 10 mins of stretching and relaxation. Aerobic activities were always performed between 50% and 60% of the maximum predicted heart rate, never exceeding 140 beats per min. The exercises followed the recommendations concerning physical activity practice during pregnancy according to the American College of Sports Medicine, and the ACOG.</p> <p>Control (n = 35): the control group participated in once-weekly sessions that included relaxation (respiratory exercises and light stretching but no aerobic or weight-resistance exercises) and focus group discussions concerning maternity. Control participants were neither encouraged to exercise nor discouraged from exercising.</p>
Outcomes	<p>Weight gain, low birthweight, prematurity.</p> <p>Weight gain was calculated from difference between weight at baseline and weight after 12 weeks of intervention.</p>
Notes	<p>At baseline; age (exercise, control) 26.0 ± 3.4, 28.6 ± 5.9 years.</p> <p>BMI (exercise, control) 28.0 ± 2.1, 27.5 ± 2.1 kg/m².</p> <p>Gestational age (exercise, control) 17.5 ± 3.3, 18.4 ± 3.9 weeks.</p>

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Women were randomised following a blocked sequence generated from a random number table by a statistician not participating in other aspects of the study.
Allocation concealment (selection bias)	Low risk	The study co-ordinator implemented the randomisation by using numbered, opaque envelopes.
Blinding of participants and personnel (performance bias) All outcomes	High risk	Unblinded.
Blinding of outcome assessment (detection bias) All outcomes	Low risk	The same cardiologist, blinded to treatment allocation, performed both tests. The anaerobic threshold was determined by review of the gas exchange curves by 2 cardiologists working independently and blinded to treatment allocation.
Incomplete outcome data (attrition bias) All outcomes	High risk	Loss to follow-up 22%, 19.6%, and 23.9% in intervention and control groups.
Selective reporting (reporting bias)	Unclear risk	Could not determine.

Santos 2005 (Continued)

Other bias	High risk	Women in the intervention group were somewhat younger, had higher physical activity, and were earlier in their pregnancy.
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Stafne 2012

Methods	RCT conducted at St Olavs Hospital, Trondheim University Hospital, and Stavanger University Hospital in Norway with recruitment from April 2007 to June 2009.	
Participants	855 randomised, 702 analysed. Inclusion criteria: white women aged 18 years or older with a singleton live fetus. Exclusion criteria: high-risk pregnancies or diseases that could interfere with participation (or both). For practical reasons, women who lived too far from the hospitals to attend weekly training groups (more than 30-min drive) were excluded.	
Interventions	Intervention group: 12 weeks regular standardised exercise program including aerobic activity, strength training, and balance exercises. The exercise program followed standard recommendations and included moderate-intensity to high-intensity activity 3 or more days per week. Physiotherapist-supervised training sessions of 60 mins in groups of 8-15 women were offered once per week. Control group: routine care (women were not discouraged from exercising).	
Outcomes	Primary outcome: GDM, insulin resistance. Secondary outcomes: maternal weight, BMI, newborn weight, gestational age, Apgar score.	
Notes	Baseline assessment at 18-22 weeks, outcomes assessed at 32 to 36 weeks' gestation. Age (intervention, control): 30.5 [4.4]/ 30.4 [4.3]. Enrolment gestational age was 18-22 weeks. Recruitment BMI: 24.7 [3]/25 [3.4].	

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	"Concealed randomization in blocks of 30 was performed at the Unit for Applied Clinical Research, by a Web-based computerized procedure."
Allocation concealment (selection bias)	Low risk	"concealed randomisation."
Blinding of participants and personnel (performance bias) All outcomes	High risk	"Because of the nature of the study it was not blinded."
Blinding of outcome assessment (detection bias) All outcomes	Low risk	Assessment of primary outcome (insulin resistance) "was blinded for group allocation".
Incomplete outcome data (attrition bias) All outcomes	High risk	18% dropout overall with more dropouts in the control group (24% vs the intervention group 13%).

Stafne 2012 (Continued)

Selective reporting (reporting bias)	Unclear risk	Could not determine. ITT performed.
Other bias	Low risk	None noted. Baseline characteristics similar.

Szmeja 2011

Methods	RCT conducted in Adelaide, Australia. Study period not stated.	
Participants	High risk. 193 women included. Inclusion criteria: women with a BMI \geq 25 kg/m ² and a live singleton pregnancy between 10 and 20 weeks' gestation. Exclusion criteria not stated.	
Interventions	Intervention group (98 women): received an "informational DVD". Control group (95 women): "No DVD".	
Outcomes	Self-reported knowledge of health dietary and lifestyle choices, satisfaction with pregnancy care.	
Notes	No statistically significant differences reported. Authors concluded that the intervention was not effective.	

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Not described.
Allocation concealment (selection bias)	Unclear risk	Not described.
Blinding of participants and personnel (performance bias) All outcomes	Unclear risk	Not described.
Blinding of outcome assessment (detection bias) All outcomes	Unclear risk	Appear to be self-reported outcomes only.
Incomplete outcome data (attrition bias) All outcomes	Unclear risk	Insufficient information to make a judgement.
Selective reporting (reporting bias)	Unclear risk	Insufficient information to make a judgement.
Other bias	Unclear risk	This report has not been published in full, possibly because the intervention was not effective.

Thornton 2009

Methods	RCT, set in the ambulatory obstetric clinics of 3 tertiary care medical centres - Morristown Memorial Hospital, St Luke's-Roosevelt Hospital Center, and Jamaica Hospital Medical Center. Each study site was an urban, public clinic of a teaching hospital, New York Medical College.
Participants	<p>Inclusion criteria: pregnant with a single fetus between 12 and 28 weeks of gestation that had a BMI greater than or equal to 30 kg/m².</p> <p>Exclusion criteria: women with pre-existing diabetes, hypertension, or chronic renal disease.</p>
Interventions	<p>Intervention (n = 116): monitored group; counselled in nutrition by a registered dietitian and given a more detailed dietary intake protocol. The nutrition program for the monitored women followed dietary guidelines similar to those used in women with the diagnosis of gestational diabetes. The women in this group were asked to record in a diary all of the foods and beverages eaten during each day.</p> <p>Control (n = 116): unmonitored group; counselled in nutrition by a registered dietitian regarding conventional prenatal nutrition guidelines.</p>
Outcomes	<p>Weight gain, weight retention (calculated from the difference between weight at 6 weeks' postpartum and weight at baseline).</p> <p>GDM, pre-eclampsia, gestational hypertension, haemorrhage/infection postpartum, preterm delivery (< 37 weeks), labour induction, caesarean delivery, macrosomal infant (> 4500 g).</p> <p>Weight gain was weight difference between the baseline(12-28 weeks) pregnancy weight and weight before delivery.</p>
Notes	<p>Age (intervention, control) 26.8, 27.3.</p> <p>BMI (intervention, control) 37.41 ± 7.01, 38.22 ± 7.48 kg/m².</p>

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	A random-number table was used to assign each consecutively numbered envelope to either the study or control group in blocks of 10.
Allocation concealment (selection bias)	Low risk	Envelopes were prepared and sequentially numbered. A card indicating the assigned group was placed in the envelope, and the envelope was sealed.
Blinding of participants and personnel (performance bias) All outcomes	Unclear risk	Not described.
Blinding of outcome assessment (detection bias) All outcomes	Unclear risk	Not described.
Incomplete outcome data (attrition bias) All outcomes	Low risk	The ITT principle was performed. Loss to follow-up 9.7%.
Selective reporting (reporting bias)	Unclear risk	Could not determine.
Other bias	Low risk	Demographic data for the randomised groups were comparable.

Vesco 2013

Methods	Parallel-arm RCT conducted by Harvard Medical School, USA.
Participants	<p>160 planned, 114 randomised so far.</p> <p>Inclusion criteria: women aged 18 or older, who were obese at the beginning of pregnancy (BMI \geq 30 kg/m²); 10-20 weeks' gestation.</p> <p>Exclusion criteria: gestational age > 20 weeks, multifetal pregnancy, anticipated disenrolment prior to delivery, non-English speaking, plans to move within the year, type 1 or 2 diabetes mellitus (or gestational diabetes), and other medical conditions that require specialised nutritional care (e.g. history of bariatric surgery) or conditions that may affect weight gain (e.g. severe hyperemesis gravidarum).</p>
Interventions	<p>Intervention group: lifestyle intervention (diet plus exercise) (n = 56). Following randomisation, all participants receive a 45-min dietary consultation. They were encouraged to follow the Dietary Approaches to Stop Hypertension diet (DASH) without sodium restriction and received an individualised calorie intake goal, a second individual counselling session and attend weekly group meetings (90 min) with weigh-ins, food and activity logs until they give birth. Women are encouraged to accumulate at least 30 min of moderate intensity activity per day. Pedometers recorded steps with at target of 10,000 steps daily and were only provided to the intervention group.</p> <p>Control group: usual care (n = 58) with a 1-time advice session about healthy eating.</p>
Outcomes	<p>Primary outcomes: GWG, excessive weight gain, postpartum weight retention at 1 year (mean difference between postpartum and baseline weight), proportion of LGA neonates.</p> <p>Secondary outcomes: feasibility and acceptability of the intervention, maternal dietary intake and physical activity, and infant birthweight, feeding patterns, and growth during the first year of life.</p>
Notes	<p>Median age (intervention, control): 29 (27-32), 29 (26-31).</p> <p>Mean BMI 36.7 (5.2) / 36.8 (4.7).</p> <p>21% of sample had BMI > 40 kg/m².</p> <p>Data collection at 34-weeks' gestation and at 2-weeks' and 1-year postpartum.</p> <p>Enrolment at 10-20 weeks' gestation.</p>

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	"Randomisation ...using a computerised algorithm to generate the random assignments in blocks of four."
Allocation concealment (selection bias)	Unclear risk	Not described.
Blinding of participants and personnel (performance bias) All outcomes	Unclear risk	Not described.
Blinding of outcome assessment (detection bias) All outcomes	Unclear risk	Not described.
Incomplete outcome data (attrition bias)	Low risk	Good follow-up achieved.

Vesco 2013 (Continued)

All outcomes

Selective reporting (reporting bias)	Low risk	Prespecified outcomes were reported. ITT analysis.
Other bias	Unclear risk	Follow-up weight gain data were collected at 34 weeks (i.e. earlier than most other included studies).

Vinter 2012

Methods	RCT conducted at 2 university hospitals in Odense, Denmark from October 2007 to October 2010.	
Participants	360 randomised, 304 analysed. Included obese women aged 18-40 years, 10-14 weeks' gestation, BMI of 30-45kg/m ² . Excluded if chronic medical conditions, prior serious obstetric complications, alcohol/drug abuse, non-Danish speaking, multiple pregnancy, positive GTT.	
Interventions	Intervention group: a lifestyle intervention consisting of dietary counselling and exercise (n = 180). The intervention involved dietary advice on 4 occasions (15, 20, 28 and 35 weeks) by a dietician. Energy requirements were personalised for each participant. Exercise intervention included a pedometer, free gym membership for 6 months, encouraged to do 30-60 min moderate physical activity daily. At the gym they had closed training classes with a physiotherapist for 1 hour each week. Control group: routine care (n = 180).	
Outcomes	GWG, pre-eclampsia, hypertension, GDM, caesarean section, macrosomia, LGA, admission to NICU, maternal weight retention at 6 months postpartum, infant and childhood weight.	
Notes	GWG was defined as weight gain at 35 weeks. Obstetric and neonatal outcomes were obtained from medical records. Childhood weight not yet reported. Age (intervention, control): 29 (27-32)/29 (26-31). Enrolment gestational age was 10-14 weeks. Recruitment BMI: 33.4 (31.7-36.5)/33.3 (31.7-36.9).	

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	"computer-generated numbers" 1:1, stratified for smoking.
Allocation concealment (selection bias)	Low risk	"sealed envelopes."
Blinding of participants and personnel (performance bias) All outcomes	Unclear risk	Not described.
Blinding of outcome assessment (detection bias) All outcomes	Unclear risk	Not described.

Vinter 2012 (Continued)

Incomplete outcome data (attrition bias) All outcomes	Low risk	56/360 (15%) dropped out for primary outcomes. Similar between groups.
Selective reporting (reporting bias)	Low risk	All expected outcomes reported.
Other bias	Low risk	None noted. Baseline characteristics comparable.

Vitolo 2011

Methods	RCT (pilot study), set in primary care settings in Porto Alegre, Brazil.	
Participants	<p>Inclusion criteria: gestational age between 10 and 29 weeks; women attending the prenatal care unit of the health unit.</p> <p>Exclusion criteria: positive testing for HIV, previous diagnostic of diabetes, hypertension, anaemia or another condition that needed a special diet and age over 35 years.</p>	
Interventions	<p>Intervention group: (159 women) weight and diet were assessed at recruitment. The aim of the intervention was to improve diet and encourage weight-appropriate weight gain in pregnancy. For low weight women, the priority was increasing the energetic density of the meals. For normal weight women, daily consumption of vegetables, greens, fruit and water were encouraged and women were advised to restrict consume of fat-rich foods and oil in cooking. For the overweight women, the intervals between meals were prioritised and women were encouraged to restrict their consumption of snacks. Women received a further interview 1 month later to reinforce messages.</p> <p>Control group: (162 women) women did not receive any special intervention but were informed about their weight and nutritional status and advised to seek professional help if they were under or overweight. Their doctors were also provided with the results of the nutritional evaluation.</p>	
Outcomes	Weight gain.	
Notes	Reported average weekly weight gain which was significantly lower in the overweight women in the intervention group than the control group (342.2 g [143.6] vs 420 g [185.4]; P = 0.01).	

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Women were randomised by means of a dark pouch with 2 equal sized cubes containing the term intervention in 1 and control in the other.
Allocation concealment (selection bias)	Unclear risk	2 cubes were concealed in a dark pouch and 1 was removed at the point of randomisation which indicated allocation. (It is possible that this could be changed by the person carrying out randomisation.)
Blinding of participants and personnel (performance bias) All outcomes	Unclear risk	Not described.
Blinding of outcome assessment (detection bias) All outcomes	Unclear risk	Not described.

Vitolo 2011 (Continued)

Incomplete outcome data (attrition bias) All outcomes	Low risk	315 women accepted participation in the study. There were 307 women with anthropometric data collected in the last trimester.
Selective reporting (reporting bias)	Unclear risk	The results relate to the number of women with excessive or low weight gain at different gestational ages.
Other bias	Unclear risk	'Risk of bias' assessment from translated notes.

Wilkinson 2012

Methods	RCT conducted at a maternity hospital in Australia with recruitment from August 2010 to March 2011.	
Participants	Randomised 360, analysed 242. Included if attending their booking visit at the MH research site and were 18 years or older (or under 18 years, with the consent of a parent or guardian). Excluded if unable to read and speak English at a level that allowed completion of pen-and-paper surveys.	
Interventions	Intervention group: a lifestyle intervention (diet plus exercise, smoking cessation, etc) (n = 178) consisting of a 1-hour 'Healthy start to pregnancy' workshop with a 12 page booklet with evidence based information, with goal setting and self-monitoring activities. Control group: routine care (n = 182).	
Outcomes	Good nutrition, PA, GWG awareness, number of cigarettes smoked, BMI.	
Notes	Outcomes assessed at recruitment and 12 weeks later at around 26 weeks. Age (intervention, control): 29.5 [5.1]/29 [4.7]. Enrolment gestational age: 14.5 [3]/14.2 [3]. Prepregnancy BMI: 25.4 [5.2]/24.6 [5.5]. ITT analysis showed increased weekly activity scores in mins in the intervention group. Only per protocol analyses showed significant differences in diet quality and mean servings of vegetables and fruit in the intervention group at the follow-up interview (26 weeks).	

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	"computerized randomisation process."
Allocation concealment (selection bias)	Low risk	"allocation was concealed using sealed opaque envelopes."
Blinding of participants and personnel (performance bias) All outcomes	Unclear risk	Not described.
Blinding of outcome assessment (detection bias)	Unclear risk	Assessor blinding was not described. Most outcomes, including activity scores and food consumption were self-reported.

Wilkinson 2012 (Continued)

All outcomes

Incomplete outcome data (attrition bias) All outcomes	High risk	Only half the women attended the workshop, and overall response at the second assessment was 67%.
Selective reporting (reporting bias)	Unclear risk	Could not determine. Reported ITT and per protocol analyses. Few review outcomes reported. Little usable data.
Other bias	Low risk	Baseline characteristics overall were comparable.

Wolff 2008

Methods	RCT, set in Copenhagen, Denmark.	
Participants	Inclusion criteria: pregnant obese women (BMI > 30 kg/m ²), nondiabetic non-smoking and Caucasian recruited at 15 ± 3 weeks of gestation. Exclusion criteria: smoking, age < 18 or > 45, multiple pregnancy, or medical complication.	
Interventions	Intervention (n = 23): restriction of GWG to 6-7 kg by 10 consultation of 1 hour each with trained dietitian. The women were instructed to eat a healthy diet according to the official Danish dietary recommendations (% fat, protein, CHO, 30, 15-20, 50%-55%). The energy intake was restricted based on individually estimated energy requirements and estimated energetic cost of fetal growth. Control (n = 27): the control group had no consultations with the dietitian and had no restrictions on energy intake or GWG. All participants followed the routine clinical schedule.	
Outcomes	Weight gain, weight retention at 4 weeks' postpartum, pre-eclampsias, caesarean delivery. Weight gain was calculated as difference between self-reported prepregnancy weight and weight just before delivery.	
Notes	Age (intervention, control) 28 ± 4, 30 ± 5 years. Gestational age (intervention, control) 15 ± 2, 16 ± 3 weeks. BMI at inclusion visit (intervention, control) 34.9 ± 4, 34.6 ± 3 kg/m ² .	

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	The computerised randomisation took place after the women had given written informed consent.
Allocation concealment (selection bias)	Unclear risk	No information provided.
Blinding of participants and personnel (performance bias) All outcomes	Low risk	The physicians and midwives were blinded in regard to the treatment assignment, and women were asked not to reveal their allocation.
Blinding of outcome assessment (detection bias)	Unclear risk	Not described.

Wolff 2008 (Continued)

All outcomes

Incomplete outcome data (attrition bias) All outcomes	High risk	Loss to follow-up 24%: 17.8% in intervention group, 28.9% in control group.
Selective reporting (reporting bias)	Unclear risk	Could not determine.
Other bias	Low risk	Baseline characteristics were similar.

ACOG: the American Congress of Obstetricians and Gynecologists

ANC: antenatal clinic

BMI: body mass index

BP: blood pressure

CHO: carbohydrate

GDM: gestational diabetes mellitus

GI: glycaemic index

GWG: gestational weight gain

HbA1C: haemoglobin A1C

HGI: high glycaemic index

Hi-Lo: high-low exercise

IOM: Institute of Medicine

ITT: intention-to-treat

LGA: large-for-gestational age

LGI: low glycaemic index

Lo-Hi: low-high exercise

min: minutes

Mo-Mo: moderate-moderate exercise

n: number

NICU: neonatal intensive care unit

NR: not reported

OGTT: oral glucose tolerance test

QoL: quality of life

RCT: randomised controlled trial

RDA: recommended dietary allowance

SD: standard deviation

SGA: small-for-gestational age

VLDL: very low-density lipoprotein

vs: versus

Characteristics of excluded studies [ordered by study ID]

Study	Reason for exclusion
Asemi 2011	RCT of effect of probiotic yogurt during pregnancy on inflammatory factors, lipid profiles, oxidative stress and insulin resistance, not on preventing excessive weight gain.
Bechtel-Blackwell 2002	Quasi-RCT.
Boileau 1968	Irrelevant intervention.
Breslow 1963	Non-RCT.
Campbell 2004	Participants included pregnant and nonpregnant women.
Daley 2014	Abstract of the process evaluation of an RCT.

Study	Reason for exclusion
Davenport 2011	Quasi-RCT of a target weight program intervention in pregnancy.
Faucher 2008	It was not clear that women in this study were pregnant (community weight loss intervention).
Graham 2014	Formative research for e-Mons study not RCT results.
Gray-Donald 2000	Non-RCT.
Hauner 2012	RCT omega-3 fatty acids on infant adipose tissue, not an intervention to reduce excessive weight gain in pregnancy.
Hausenblas 2008	Participants included both pregnant and postpartum women.
Ismail 1990	Not a relevant intervention. This study examined the use of cefoxitin (an antibiotic) for the prevention of post-caesarean-section infection.
Kinnunen 2007	Non-RCT.
Lindsay 2014	Abstract of RCT (probiotics) without gestational weight gain outcomes.
Maitland 2014	Abstract of a pilot cross-over study of only 16 women to evaluate a dietary supplement.
Mohebi 2009	Quasi-RCT protocol.
Moses 2006	Quasi-RCT.
Mottola 2010	Not a RCT.
Olson 2004	Non-RCT.
Silverman 1971	Irrelevant intervention.
Stutzman 2010	Quasi-RCT on the effect of exercise on blood pressure and heart rate variability, not excessive weight gain.
Te Morenga 2011	This study did not include pregnant women.
Walker 1966	Non-RCT.
Wisner 2006	Participants were postpartum women.

RCT: randomised controlled trial

Characteristics of studies awaiting assessment *[ordered by study ID]*

[Shakeri 2012](#)

Methods	This study requires translation from Farsi before it can be classified.
Participants	
Interventions	
Outcomes	

Shakeri 2012 (Continued)

Notes

Characteristics of ongoing studies [ordered by study ID]

Astrup 2013

Trial name or title	An optimised programming of healthy children (APPROACH).
Methods	RCT, single blind, parallel assignment. Location: Denmark.
Participants	390 obese pregnant women.
Interventions	High-protein/low-GL diet vs low-protein/high-GL diet.
Outcomes	Primary: GWG, changes in bodyweight, body composition, body fat. Secondary: growth and development of fetus.
Starting date	01/11/2013.
Contact information	Nina RW Geiker, nina.rica.wium.geiker@regionh.dk, Copenhagen University Hospital at Herlev.
Notes	Estimated completion date: December 2015 (final data collection date for primary outcome measure).

Atkinson 2013

Trial name or title	Be healthy in pregnancy (B-HIP): an RCT to study nutrition and exercise approaches for healthy (BHIP).
Methods	RCT, 2-arm randomised 1-site trial, parallel assignment, single blind. Location: Canada.
Participants	110 women with singleton pregnancies. Excluded: currently breastfeeding previous child, pregnancy resulting from in vitro fertilisation, and others.
Interventions	Nutrition (energy high protein, low fat diet) and exercise (aerobic) vs standard prenatal care.
Outcomes	GWG within IOM guidelines, maternal and infant outcomes.
Starting date	01/07/2012.
Contact information	Stephanie A Atkinson, PhD, satkins@mcmaster.ca, McMaster University.
Notes	Estimated completion date: November 2016 (final data collection date for primary outcome measure).

Barakat 2012

Trial name or title	Effect of a supervised exercise program in obese and overweight pregnant women on outcomes and level of depression.
Methods	RCT. Location: Spain.
Participants	150 obese and overweight pregnant women. Inclusion criteria <ul style="list-style-type: none"> · Being healthy and able to exercise following American College of Obstetricians and Gynecologists (ACOG) guidelines. · Being able to communicate in Spanish. · Giving birth at Hospital Universitario de Fuenlabrada. · Having a BMI greater than 24.9. Exclusion criteria <ul style="list-style-type: none"> · Multiparity. · Obstetrician complications. · Being interested in the study after 18 weeks. · Not being regular in physical exercise program (minimum adherence 80%). · Younger than 18 years old.
Interventions	Behavioural: exercise group. Supervised physical conditioning program of 3, 55-60 minute sessions per week during whole pregnancy (from week 9 to 38). Each session consists of 25-30 minutes of cardiovascular exercise, 10 minutes of specific exercises (strength and balance exercises), and 10 minutes of pelvic floor muscles training. Aerobic activity was prescribed at light-to-moderate intensity, aiming for 55-60 of maximal heart rate. All women wore a heart rate (HR) monitor (Polar FT7) during the training sessions to ensure that exercise intensity was light-to-moderate.
Outcomes	Primary outcomes: change from level of depression at the end of the pregnancy [Time frame: Up to 36 weeks] The Center for Epidemiological Studies-Depression scale (CES-D) was administered to all obese and overweight pregnant women at the beginning and at the end of their pregnancies. Secondary outcomes <ul style="list-style-type: none"> · Maternal GWG [Time frame: 40-42 weeks]. · Maternal outcomes [Time frame: after labour]. · Fetal weight [Time frame: after labour].
Starting date	October 2009.
Contact information	Ruben Barakat, PhD, barakatruben@gmail.com , Universidad Politécnica de Madrid, Spain.
Notes	Final data collection date for primary outcome measure, January 2013.

Brownfoot 2011

Trial name or title	Weighing in pregnancy.
Methods	RCT.
Participants	Pregnant women attending for antenatal care at < 20 weeks' gestation 18-45 years. Excluded multiple gestation or medical or psychiatric illness. (Target sample size 650.)
Interventions	Weighing as part of each antenatal visit compared with routine care.
Outcomes	Weight gain within IOM and WHO recommendations; medical complications of pregnancy (pre-eclampsia, hypertension, gestational diabetes); need for induction of labour; mode of delivery; postpartum complication; infant birthweight; macrosomia and complications relating to macrosomia.
Starting date	1st January 2010.
Contact information	fiona.brownfoot@thewomens.org.au
Notes	Emailed 22/9/14.

Callaway 2012

Trial name or title	Probiotics for the prevention of gestational diabetes in overweight and obese women.
Methods	RCT, placebo, parallel, blinded. Location: Australia.
Participants	640 obese and overweight women. 18 to 50 years. Excluded: gestation > 16 weeks, pre-existing diabetes, pre-existing impaired fasting glucose or impaired glucose tolerance, GDM on early screening, and others.
Interventions	Diet (administration of probiotics) vs placebo.
Outcomes	Gestational diabetes. GWG. pre-eclampsia, induction of labour, caesarean section. neonatal outcomes, biochemical and other outcomes.
Starting date	01/06/2012.
Contact information	Prof Leonie Callaway, l.callaway@uq.edu.au, Royal Brisbane and Women's Hospital.
Notes	

Chasan-Taber 2009

Trial name or title	A RCT of prenatal physical activity to prevent gestational diabetes: design and methods.
Methods	RCT. A blocked randomisation is used such that both treatment groups are assigned an equal number of times in each set of 4 sequentially enrolled women.
Participants	Location: Bay State Medical Center in western Massachusetts.

Chasan-Taber 2009 (Continued)

Target number of participants: 364.

Inclusion criteria: women are sedentary, with a diagnosis of GDM in a prior pregnancy defined according to American Diabetes Association (ADA) criteria.

Exclusion criteria: age < 18 or > 40 years, history of diagnosis of diabetes outside of pregnancy, hypertension, heart disease or chronic renal disease, current medications that adversely influence glucose tolerance, > 16 weeks' gestation, contraindications to participating in moderate-physical activity, inability to read English at a 6th grade level, self-reported participation in > 30 minutes of moderate-intensity or vigorous-intensity exercise on > 3 days/week, and non singleton pregnancy.

Interventions	<p>Exercise intervention: person education on exercise followed by weekly, biweekly and monthly mail and telephone follow-up.</p> <p>Health and wellness intervention: person education health and wellness followed by weekly and monthly mail and telephone follow-up.</p>
Outcomes	Maternal weight gain (change in weight from pregravid to delivery), birthweight, Apgar score, caesarean delivery, macrosomia (> 4000 g) and LGA, defined as newborn weight the 90th percentile for completed gestational weeks using cutoff points defined by Oken.
Starting date	April 2010.
Contact information	<p>Lisa Chasan-Taber; lct@schoolph.umass.edu</p> <p>Megan Ward Harvey, meward@schoolph.umass.edu</p>
Notes	1 paper has been published (Hawkins 2014). It found that the exercise arm had significantly greater increases in sports or exercise activity. Findings on GWG and neonatal outcomes are pending.

Chasan-Taber 2013

Trial name or title	Lifestyle intervention in overweight and obese pregnant Hispanic women.
Methods	<p>RCT, parallel, double blind.</p> <p>Location: USA.</p>
Participants	<p>Estimated enrolment 333.</p> <p>Overweight or obese Hispanic women 16-45 years old.</p> <p>Excluded if type 2 diabetes, heart disease, or chronic renal disease. multi-gestational, and other exclusions.</p>
Interventions	PA and diet intervention materials and health education vs standard prenatal care.
Outcomes	Insulin resistance, GWG, postpartum weight loss, postpartum cardiovascular risk and others.
Starting date	01/01/2014.
Contact information	Lisa Chasan-Taber, ScD, lct@schoolph.umass.edu, University of Massachusetts, Amherst
Notes	Estimated completion date: 01/12/2018.

Choi 2011

Trial name or title	A pilot study of a mobile phone-based physical activity program in pregnant women.
Methods	RCT, parallel, single blind. Location: USA.
Participants	30 physically inactive women at 10 - 20 weeks' gestation with pre-pregnancy BMI \geq 18.5. Excluded if known medical or obstetric complication that restricts physical activity. History of eating disorders.
Interventions	Study mobile phone app and activity monitor vs activity monitor.
Outcomes	Physical activity, measured steps.
Starting date	01/10/2012.
Contact information	JiWon Choi, PhD, no email given, University of California, San Francisco.
Notes	Estimated completion date: May 2014.

Downs 2011

Trial name or title	Determinants and outcomes of physical activity in pregnancy: findings from active MOMS, a randomised physical activity intervention for pregnant women.
Methods	RCT.
Participants	Pregnant women (inclusion and exclusion criteria not described).
Interventions	2 physical activity interventions and a control group. 1 group received a structured intervention with face-to-face physical activity education, motivational support and moderate-physical activity on 2 days per week for 70 mins with an instructor. The 2nd group (lifestyle support) received educational support via mailed materials and phone support. The control group received standard care.
Outcomes	Performance (physical activity).
Starting date	
Contact information	Danielle S Downs, The Pennsylvania State University, University Park, PA, USA.
Notes	Study reported in brief abstract with preliminary findings.

Farajzadegan 2013

Trial name or title	Maternal-centred life-style modification program for weight gain management during pregnancy.
Methods	RCT. Location: Iran.
Participants	160 pregnant women between 6 to 10 weeks' gestational age who have no condition that requires medical care nor drug taking.

Farajzadegan 2013 *(Continued)*

Interventions	Nutrition and exercise (educational package, prenatal care log book and 10, 20-minute counselling sessions) vs standard prenatal care.
Outcomes	GWG, BMI.
Starting date	Not stated.
Contact information	Dr Zahra Amini Pozveh, aminizahra2005@yahoo.com, Isfahan University of Medical Sciences.
Notes	

Fernandez 2011

Trial name or title	Electronically-mediated weight interventions for pregnant and postpartum women.
Methods	RCT, 3-armed, parallel, double blind. Location: USA.
Participants	Estimated enrolment 1641 pregnant women at or before 20 weeks' gestation. Excluded BMI < 18.5 and > 35, multiple gestation, any previous conditions that could interfere with weight loss.
Interventions	Behavioural intervention through a website during pregnancy and until 18 months postpartum or intervention through website during pregnancy only vs non weight-related content.
Outcomes	GWG, postpartum weight retention, caloric intake, PA.
Starting date	01/05/2011.
Contact information	Diana Fernandez, no email given, University of Rochester.
Notes	Estimated completion date December 2014.

Ferrara 2014

Trial name or title	A pragmatic cluster randomised clinical trial of diabetes prevention strategies for women with gestational diabetes: design and rationale of the Gestational Diabetes' Effects on Moms (GEM) study.
Methods	Cluster-RCT, multicentre, blinded. Location: USA.
Participants	2,320 women with a GDM diagnosis between March 27, 2011 and March 30, 2012. Excluded: neonatal loss, no telephone contact.
Interventions	Nutrition and exercise (diabetes prevention program-derived print/telephone lifestyle intervention of 13 telephonic sessions) vs usual care.

Ferrara 2014 (Continued)

Outcomes	Proportion of women who reach a postpartum weight goal and total weight change. Postpartum glycaemia, blood pressure, depression, percent of calories from fat total caloric intake and physical activity levels.
Starting date	March 27, 2011.
Contact information	Assiamira Ferrara, Assiamira.Ferrara@kp.org, Kaiser Permanente Northern California.
Notes	

Goldberg 2012

Trial name or title	Randomised control pilot of a behaviour-based exercise and diet intervention to reduce risk factors for gestational diabetes among otherwise healthy pregnant women.
Methods	RCT, parallel, open label. Location: USA.
Participants	30 healthy first trimester pregnant women 18 to 40 years. Excluded: hypertension, diabetes, known cardiopulmonary disease; orthopaedic problems or other conditions that would prevent regular physical activity.
Interventions	Nutrition and exercise (20 interactive weekly sessions to promote daily exercise, vegetable and fruit intake, maintain a diet that is relatively lower in fat and rich in whole grains) vs standard medical care.
Outcomes	Achieving 30 minutes of daily exercise, 4 or more times each week. Eating 5 or more servings of vegetables and/or fruits each day, pregnancy weight gain, fasting glucose, HbA1C, pregnancy weight gain, blood pressure, lipid and lipoprotein levels, pedometer records and more.
Starting date	01/11/2012.
Contact information	Linn Goldberg MD, goldberl@ohsu.edu, Oregon Health and Science University.
Notes	

Graziano 2013

Trial name or title	WATE study - gestational weight gain and the electronic medical record.
Methods	RCT, parallel, open label. Location: USA.
Participants	Estimated enrolment 300. Pregnant women with a single intrauterine gestation. Excluded multiple gestation pregnancy.

Graziano 2013 (Continued)

Interventions	Weight alerts (electronic medical record popup/highlight in their chart, displaying the weight gain, patient perception, recommended guidelines for weight gain in pregnancy) vs usual display, with no flag nor highlight.
Outcomes	Weight gain, primary outcome will be measured as the percent of patients who achieve their recommended weight gain goal in pregnancy.
Starting date	01/10/2013.
Contact information	Scott Graziano, MD MS, sgrazia@lumc.edu, Loyola University.
Notes	Estimated primary completion date: October 2014 (final data collection date for primary outcome measure).

Hivert 2012

Trial name or title	Intervention to promote changes of healthy lifestyle (physical activity and nutrition) during gestation.
Methods	RCT, parallel, open label. Location: Canada.
Participants	Estimated enrolment of 50 overweight or obese pregnant women at risk of developing diabetes mellitus. Excluded if pre-pregnancy diabetes detected in the first trimester, multiple gestation, taking medications that can affect blood sugar or weight.
Interventions	Healthy lifestyle counselling and PA sessions once a week until week 36 of gestation vs information about the recommended weight gain during pregnancy and an evaluation about of their nutritional and PA habits.
Outcomes	Weight change during pregnancy, levels of maternal and fetal adipokines, maternal and fetal glycaemic control, healthy lifestyle and others.
Starting date	01/12/2011.
Contact information	Marie-France Hivert, marie-france.hivert@usherbrooke.ca, Universitaire de Sherbrooke.
Notes	Estimated completion date: January 2014. Emailed 25/9/14. Unpublished pilot study data for 20 women was received on the 17/11/14.

John 2014

Trial name or title	Healthy eating and lifestyle in pregnancy (HELP): a protocol for a cluster-randomised trial to evaluate the effectiveness of a weight management intervention in pregnancy.
Methods	Cluster-RCT, blinded. Location: UK.
Participants	Target recruitment of 570 pregnant women aged 18 years or over, with a BMI ≥ 30 (kg/m ²) and between 12 and 20 weeks' gestation.

John 2014 (Continued)

	Excluded if unable to understand English, any pregnancy-related complications, any previous medical complications, any nutritional complications, involved in other research.
Interventions	Nutrition and exercise (weekly 1.5-hour weight management group) vs usual care and 2 leaflets giving advice on diet and physical activity.
Outcomes	BMI at 12 months postpartum, GWG, QoL, mental health, waist-hip ratio, child weight centile, admission to neonatal unit, diet, and others.
Starting date	Not stated.
Contact information	Elinor John, simpsonsa@cf.ac.uk, Cardiff University.
Notes	

King 2013

Trial name or title	Postprandial response to almond consumption in overweight Hispanic pregnant women.
Methods	RCT, cross-over, single blind (investigator). Location: USA.
Participants	Estimated enrolment 20 overweight or obese pregnant Hispanic women between 30 and 36 weeks' gestation. Excluded if diagnosis of GDM, pre-existing diabetes mellitus, renal disease, thyroid disease, cardiovascular disease, history of drug abuse, nut allergies.
Interventions	Almond meal (bagel, almond butter and apple juice) vs bagel with cream cheese and apple juice.
Outcomes	Markers for glucose intolerance, serum triglyceride concentrations. Secondary: Metabolic markers, glucose, insulin, hormonal and inflammatory markers, satiety markers.
Starting date	September 2011.
Contact information	Lisa R Sawrey-Kubicek, MS, RD, lsawreykubicek@chori.org, Children's Hospital & Research Center Oakland.
Notes	Estimated completion date: December 2013. Emailed 25/9/14.

Ko 2010

Trial name or title	Effect of physical activity on metabolic syndrome in pregnancy and fetal outcome.
Methods	RCT, single blind (investigator).
Participants	Location: United States, Washington. Target number of participants: 100. Inclusion criteria: pregnant women 18-45 years old receiving prenatal care at MAMC. Exclusion criteria: women do not have a gallbladder, do not speak English, over 14 weeks pregnant at study entry, do not plan to deliver at MAMC, have medical contraindications, unwilling to par-

Ko 2010 (Continued)

	participate in exercise intervention program, < 18 years of age, currently engaged in a regular vigorous-exercise program.
Interventions	Intervention group will exercise 3 times per week at moderate-vigorous intensity for 45 minutes per session through their 36 week of pregnancy. Control group women will continue their usual physical activity throughout pregnancy.
Outcomes	Primary outcome: central adiposity. Secondary outcomes: leptin levels, glucose insulin, cholesterol, fetal adiposity, neonatal adiposity.
Starting date	October 2007.
Contact information	Cynthia W Ko, University of Washington.
Notes	

Laitinen 2013

Trial name or title	Placebo-controlled intervention study for maternal and child health.
Methods	RCT, parallel, double blind placebo-controlled. Location: Finland.
Participants	Estimated enrolment: 440 overweight healthy pregnant women less than 16 weeks' gestation. Excluded if diabetes, coeliac disease, hypo-/hyperthyroidism, increased bleeding tendency.
Interventions	Dietary supplement (comparison of probiotics, fish oil and their combination) vs placebo.
Outcomes	GDM, fasting glucose levels, prevalence of allergy in child. Secondary: management of GDM, body composition, immunologic and metabolic markers, fecal microbiota.
Starting date	September 2013.
Contact information	
Notes	Estimated primary completion date: March 2016 (final data collection date for primary outcome measure).

Li 2011

Trial name or title	Effects of dietary and lifestyle interventions in obese pregnant women from the first trimester on gestational weight gain and pregnancy outcomes.
Methods	RCT, parallel, single blind (participant). Location: China.
Participants	373 overweight or obese pregnant women gestational age between 6 and 12 weeks of gestation, pre-pregnancy ≥ 28 (kg/m ²) aged ≥ 18 years, and a singleton pregnancy.

Li 2011 (Continued)

	Excluded if prediabetes and diabetes, hypertension, chronic renal disease, thyroid disorder, gestational weeks \geq 13, multiple pregnancy, uterine malformation, physical restriction that prevents exercise.
Interventions	Dietary and lifestyle intervention (individualised dietary intake protocol - standard care intensive dietary and lifestyle intervention from first trimester to delivery, every 2-4 weeks) vs standard care.
Outcomes	GWG, from enrolment to delivery (28-34 weeks of gestation), GDM, hypertensive disorders, large-for-gestational-age infants, macrosomia, caesarean section.
Starting date	01/04/2011.
Contact information	
Notes	Emailed 25/9/14.

Liu 2011

Trial name or title	Magnesium supplementation in the second trimester of pregnancy to overweight and obese individuals.
Methods	RCT, 3-arm, parallel, double blind. Location: USA.
Participants	Estimated enrolment: 60 overweight and obese pregnant women in their first trimester between 18 and 40 years of age. Excluded if on insulin therapy or other oral hypoglycaemic agents, multiple gestation, baseline HgbA1C $>$ 6.5%, prior history of clinically diagnosed T2D, multiple dietary restrictions/food allergies, heart, renal, or liver failure, clinical history of psychiatric illness or substance abuse and other exclusions.
Interventions	Group A will receive oral magnesium citrate, group B will receive dietary counselling about following a magnesium rich diet) vs group C who will receive a placebo (control).
Outcomes	Maternal biomarkers, blood and urine markers, neonatal birthweight/height, macrosomia, preterm birth, head circumference, and Apgar score and more.
Starting date	01/01/2012.
Contact information	Simin Liu, Dr, no email given, University of California, Los Angeles.
Notes	

McAuliffe 2013

Trial name or title	Pregnancy, exercise and nutrition research study with app support.
Methods	Single centre RCT. Location: Ireland.
Participants	500 women with singleton pregnancies between 10-15 weeks' gestation between the ages of 18-45 with a smart-phone, and a BMI of greater than 25 kg/m ² .

McAuliffe 2013 *(Continued)*

Excluded if pre-gestational diabetes or early onset gestational diabetes or past history of gestational diabetes, and other exclusions.

Interventions	Women in the intervention group will have standard antenatal care but will receive a 'healthy lifestyle package with app support' (a combination of a healthy diet, an exercise intervention with a smart phone application as an information and motivational source) vs controls who will receive a 'regular lifestyle package' consisting of standard antenatal care and general advice on weight gain according to BMI.
Outcomes	Gestational diabetes, GWG, glycaemic index, PA levels.
Starting date	01/01/2013.
Contact information	Professor Fionnuala McAuliffe fionnuala.mcauliffe@ucd.ie
Notes	Estimated completion date: 2016 (personal communication on 25/9/14).

Moholdt 2011

Trial name or title	Exercise training in pregnancy for obese women (ETIP): study protocol for a RCT.
Methods	RCT, parallel, blinded. Location: Norway.
Participants	150 previously sedentary obese pregnant women with singleton live fetus at an 11-14 weeks ultrasound scan. Excluded if pregnancy complications, high risk for preterm labour or diseases that could interfere with participation, and habitual exercise training.
Interventions	Physical exercise (60 mins up to 4 times per week starting in gestation week 14) vs standard antenatal care.
Outcomes	GWG, exercise capacity, endothelial function, physical activity level, body composition, serum markers of cardiovascular risk, incontinence, lumbopelvic pain and cardiac function, anthropometric variables at birth, Apgar score, serum markers of inflammation and metabolism in cord blood.
Starting date	01/09/2010.
Contact information	Trine T Moholdt, trine.moholdt@ntnu.no, Norwegian University of Science and Technology.
Notes	Estimated completion date: 2016 (personal communication on 25/9/14).

Nagle 2011

Trial name or title	Continuity of midwifery care and gestational weight gain in obese women.
Methods	RCT.
Participants	214 primiparous women attending 1 of the study hospitals for maternity care with a booking BMI > 30 and less than 17 weeks' gestation. Exclusion criteria include inability to speak English, multiple pregnancy, vaginal bleeding or serious medical condition.

Nagle 2011 *(Continued)*

Interventions	Continuity of midwifery care compared with routine management.
Outcomes	GWG; women's experience of care and satisfaction with care; psychological well being.
Starting date	Not clear.
Contact information	cate.nagle@deakin.edu.au
Notes	Emailed 25/9/14.

Nagle 2013

Trial name or title	Primary prevention of gestational diabetes for women who are overweight and obese: a RCT.
Methods	RCT, not blinded. Location: Australia.
Participants	Pregnant women who are overweight or obese, with a singleton pregnancy, less than 14 weeks' gestation and recruited from the Barwon South West region of Victoria, Australia. Excluded: with pre-existing diabetes, a past history of gestational diabetes, currently experiencing vaginal bleeding or with severe medical conditions.
Interventions	Behavioural counselling: (EDGE program from recruitment until birth, consisting of weekly contact with a brief (5-minute) phone call each fortnight) vs usual care.
Outcomes	GDM, GWG, LGA, psychological health and more.
Starting date	Not stated.
Contact information	Cate Nagle, cate.nagle@deakin.edu.au, Deakin University.
Notes	Emailed 25/9/14.

Norman 2012

Trial name or title	Efficacy of metformin in pregnant obese women: a RCT.
Methods	RCT, multicentre, placebo-controlled. Location: UK.
Participants	Caucasian obese pregnant women between 12-0 and 16+0 weeks' gestation. Excluded if non-Caucasian, gestation greater than 16 weeks, pre-existing diabetes, gestational diabetes in a previous pregnancy, systemic disease requiring regular medication, gestational diabetes in index pregnancy prior to randomisation, previous delivery of a baby less than 3rd centile or previous pregnancy with pre-eclampsia prompting delivery before 32 weeks' gestation and more.
Interventions	Medicinal (oral metformin tablets given 3 times daily to a maximum of 500 - 2500 mg daily) vs placebo.

Norman 2012 (Continued)

Outcomes	Gestational age and sex adjusted birthweight centiles of the baby, correlation between maternal insulin resistance, adverse pregnancy outcomes. Neonatal body composition, biological mechanisms of metformin, maternal anthropometry and more.
Starting date	01/02/2011.
Contact information	Prof Jane Norman, jane.norman@ed.ac.uk, University of Edinburgh.
Notes	Estimated end date: 30/11/2013.

Parat 2010

Trial name or title	Impact of education during pregnancy in overweight pregnant women (ETOIG).
Methods	RCT. Masking: single blind (participant).
Participants	Location: Hospital Necker Paris, France. Target number of participants: 800. Inclusion criteria: pregnant women who agree the study, BMI > 25 kg/m ² (BMI is based on retrospective self reported weight of the patient before pregnancy), no more than 21 weeks of gestation. Exclusion criteria: younger than 18 years, multiple gestation, high-risk pregnancy, psychiatric pathology, diabetes diagnosed before the inclusion, fetal malformation, history of obesity surgery, no understanding of French language, planning to move to another area.
Interventions	Intervention: therapeutic education; intensive training individual and collective teaching. Control: placebo comparator; classical follow-up with 2 individual consultations.
Outcomes	Primary outcomes: -30% reduction of rapid infancy weight gain at 2 years defined as > + 0.67 change in weight SD score. The 0.67 SD represents the difference between the displayed centile lines on standard infant growth charts. Secondary outcomes: -reduction of rapid infancy weight gain between 0 and 6 months; -reduction of the number of children with BMI over 19 at 2 years; -reduction of incidence of gestational diabetes, pre-eclampsia, HTA during pregnancy, caesarean, fetal macrosomia; -reduction of spontaneous feeding at 4 months; -increase of breastfeeding (number of women and duration); -reduction 1 and 2 years after pregnancy of mother weight and BMI (except 2nd pregnancy); -reduction of abnormality of lipid and glycaemia test in women, 2 years after the pregnancy.
Starting date	September 2008.
Contact information	Sophie Parat; sophie.parat@nck.aphp.fr

Parat 2010 (Continued)

 Raphael Serreau; raphael.serreau@cch.aphp.fr

Notes

Peccei 2010

Trial name or title	Nutrition intervention for the promotion of healthy weight gain during pregnancy: the Revere pregnancy weight management study.
Methods	RCT, parallel, open label. Location: USA.
Participants	300 overweight or obese pregnant women ages 18 to 49 at the first prenatal visit < 16 weeks' gestation who have and have not dieted in the past. Excluded if multiple gestation, diabetes prior to pregnancy, medical history of an eating disorder and other exclusions.
Interventions	Nutrition counselling (twice monthly interaction with a registered dietitian from 6-16 weeks' gestation through 6 months postpartum) vs current standard of optimal care in addition to 1 nutrition education session with the study nutritionist at 6-16 weeks' gestation.
Outcomes	GWG, intake of nutritious foods, hypertension and eclampsia, gestational diabetes, caesarian delivery, macrosomia, admission to neonatal intensive care unit and others.
Starting date	01/12/2009.
Contact information	Alessandra Peccei, MD, Massachusetts General Hospital.
Notes	Estimated completion date: January 2015.

Rauh 2014

Trial name or title	Rauh K, KuHealthy living in pregnancy: a cluster-randomised controlled trial to prevent excessive gestational weight gain - rationale and design of the GeliS study.
Methods	A prospective, cluster-randomised, controlled, open intervention trial.
Participants	2500 pregnant women. Inclusion criteria: women aged 18 to 43 years with a singleton pregnancy, a pre-pregnancy BMI ≥ 18.5 kg/m ² and ≤ 40 kg/m ² , and sufficient German language skills are eligible for the study. These pregnant women are recruited before the 12th week of gestation. Exclusion criteria: multiple pregnancy, high-risk pregnancy prohibiting study participation (contraindications to exercise e.g. placenta praevia, persistent bleeding, cervical incompetence etc.), prepregnancy diabetes mellitus or early gestational diabetes, uncontrolled chronic diseases (e.g. thyroid dysfunction), psychiatric or psychosomatic diseases, and any other diseases which could interfere with compliance according to the study protocol.
Interventions	Behavioural: lifestyle intervention. The intervention program consists of 4 individual counselling modules focusing on diet, physical activity and weight monitoring (12th-16th, 16th-20th, 30th-34th week of gestation and 6th-8th

Rauh 2014 (Continued)

week postpartum). The counselling sessions are given by carefully trained midwives or medical staff in combination with prenatal visits and follow a standardised curriculum. Women are provided with brochures including a list of adequate prenatal exercise programs and a pedometer. Furthermore, they receive a chart personalised according to their baseline BMI category to monitor weight development.

Outcomes	<p>Primary outcomes</p> <ul style="list-style-type: none"> -GWG. -Proportion of pregnant women showing excessive GWG according to IOM guidelines. <p>Secondary outcomes</p> <ul style="list-style-type: none"> -Incidence of gestational diabetes (24th-28th week of gestation, via an OGTT). glycosylated haemoglobin concentration (30th-34th week of gestation). -Other pregnancy complications such as pre-eclampsia. -Anthropometric measures and health status of the newborns (birthweight, height, head circumference, LGA, SGA, Apgar score, pH). -Obstetric complications (mode of delivery, induction of labour, rate of caesarean sections, etc.).
Starting date	September 2013.
Contact information	Kathrin Rauh, M.Sc. kathrin.rauh@KERN.bayern.de
Notes	Estimated completion date: September 2018.

Redman 2012

Trial name or title	Expecting success: personalised management of body weight during pregnancy.
Methods	<p>RCT, parallel, open label.</p> <p>Location: USA.</p>
Participants	<p>306 overweight or obese pregnant women between 18 and 40 years old before 12 weeks of your pregnancy.</p> <p>Excluded if pregnant with more than 1 infant, habitually smoke, abuse illegal or prescription drugs in the last 6 months, consume more than 2 alcoholic drinks per week, history of: 3 or more first trimester miscarriages, high blood pressure, type 1 diabetes, pregnancy related diabetes during screening, HIV or AIDS, psychotic disorder, major depressive episode, bipolar disorder or eating disorders and other exclusions.</p>
Interventions	Behavioural counselling (weight management counselling up to 4 times per month at clinic, plus 2 telephonic sessions) vs physician directed care.
Outcomes	GWG. PA, diet, postpartum weight retention.
Starting date	01/12/2012.
Contact information	Loren Johnson, BS, MS, loren.johnson@pbrc.edu , Pennington Biomedical Research Centre.
Notes	Estimated completion date: June 2016.

Roberts 2012

Trial name or title	Interventions to reduce excess weight gain in pregnancy in overweight and obese mothers.
Methods	RCT, parallel, open label. Location: USA.
Participants	75 over weight or obese pregnant women age 18-45 years in first trimester of pregnancy. Excluded if carrying multiple fetuses, GDM at study entry, Type 2 diabetes mellitus or blood glucose > 125 mg/dL at screening, current substance abuse, smoker, alcohol consumption of more than 1 drink per day, pre-existing medical conditions or use of medications.
Interventions	Diet counselling (Group based counselling plus Fiber Cereal or resistant starch) vs routine clinical care and no additional interventions.
Outcomes	Maternal and infant body weight change, maternal non-fasting weight, infant weight. Infant outcomes: body composition, Apgar, dietary intake. Maternal and perinatal outcomes: caesarean deliveries, gestational hypertension/pre-eclampsia, preterm birth, birth complications, fasting blood glucose and insulin concentrations throughout pregnancy.
Starting date	01/07/2012.
Contact information	Contact: Lorien E Urban, Ph.D, PregWeight@tufts.edu, Tufts University.
Notes	May 2014 (final data collection date for primary outcome measure).

Seneviratne 2014

Trial name or title	Antenatal exercise in overweight and obese women and its effects on offspring and maternal health: design and rationale of the IMPROVE (Improving Maternal and Progeny Obesity Via Exercise) RCT.
Methods	A 2-arm parallel RCT. Location: Auckland, New Zealand.
Participants	100 pregnant women aged 18 to 40 years with a BMI ≥ 25 kg/m ² who are carrying a singleton fetus less than 20 weeks of gestation, with gestation confirmed by a dating scan early in pregnancy, and who are resident in the Auckland region are eligible for the trial. Exclusion criteria include ongoing smoking during the current pregnancy or contra-indications to aerobic exercise in pregnancy as stated by ACOG.
Interventions	The exercise regimen consists of home-based stationary cycling at 20 weeks of gestation. The 16-week exercise regimen consists of 67 exercise sessions, comprising approximately 1500 minutes of moderate-intensity exercise. The frequency and duration of prescribed exercise varies over the intervention period. The intervention commences with 3 exercise sessions per week and increases to 5 sessions per week. All exercise sessions commence with a 5-minute warm-up on the stationary cycle at low intensity, maintaining heart rate below target rate, and concludes with a similar 5-minute cool down. The duration of moderate-intensity exercise at prescribed heart rate increases gradually from 15 minutes to 30 minutes per session and gradually decreases again from 33 weeks of gestation while maintaining the frequency at 5 per week. A qualified exercise physiologist maintains regular contact with the exercising participants via phone, email, and home visits. To increase compliance with exercise, if cycling becomes unacceptable or uncomfortable with advancing preg-

Seneviratne 2014 (Continued)

nancy, participants are encouraged to utilise an alternative forms of exercise such as brisk walking, while maintaining same heart rate intensity, frequency, and duration during exercise.

Outcomes	<p>Primary outcome: offspring birthweight.</p> <p>Secondary outcomes: offspring outcomes include neonatal anthropometry and body composition, fetal growth measures, cord blood metabolic markers and newborn complications including rates of LGA (birthweight > 90th centile) and SGA (birthweight < 10th centile) babies. Maternal outcomes include weight gain, aerobic fitness, quality of life, metabolic markers, postpartum weight and body composition, as well as pregnancy and delivery outcomes including timing and mode of delivery and length of hospital stay.</p>
Starting date	01/10/2012.
Contact information	Sumudu N Seneviratne (s.seneviratne@auckland.ac.nz).
Notes	

Shen 2010

Trial name or title	Impact of diet and exercise activity on pregnancy outcomes (IDEA).
Methods	Randomised, open label.
Participants	<p>Location: Canada.</p> <p>Inclusion criteria: age 18 years and older, pregnancy < 20 weeks, expressed interest in study and willingness to consent to participate in the study.</p> <p>Exclusion criteria: obstetric or medical contraindications for exercise according to 2002 SOCG guideline (ruptured membranes, preterm labour, incompetent cervix, hypertensive disorders of pregnancy, growth restricted fetus, placenta previa, persistent bleeding in 2nd or 3rd trimester, significant metabolic, cardiovascular, respiratory or systemic disorder), pre-existing diabetes (except a history of GDM, but not in current pregnancy), multiple gestations.</p>
Interventions	A community-based exercise and dietary intervention.
Outcomes	<p>Primary outcomes: excessive weight gain during pregnancy.</p> <p>Secondary outcomes: macrosomia, requirement of delivery procedures.</p>
Starting date	July 2006.
Contact information	<p>Garry Shen; gshen@ms.umanitoba.ca</p> <p>University of Manitoba.</p>
Notes	

Skouteris 2012

Trial name or title	A RCT of a specialised health coaching intervention to prevent excessive gestational weight gain and postpartum weight retention in women: the HIPPA study.
Methods	RCT.

Skouteris 2012 *(Continued)*

	Location: Australia.
Participants	220 women who have a BMI > 18.5 are 18 years of age or older, English speaking, no history of disordered eating or diabetes and are less than 18 weeks' gestation at recruitment.
Interventions	Behavioural counselling (1-on-1 sessions with a Health Coach, and 2 by 2 hour educational group sessions led by a Health Coach) vs education alone (2 by 2 hour educational group sessions with no HC components).
Outcomes	BMI, waist circumference, psychological factors.
Starting date	Not stated.
Contact information	Helen Skouteris, helen.skouteris@deakin.edu.au, Deakin University, Melbourne.
Notes	Publication pending (personal communication on 25/9/14).

Smith 2010

Trial name or title	The design of a community lifestyle programme to improve the physical and psychological well-being of pregnant women with a BMI of 30 kg/m ² or more.
Methods	RCT.
Participants	<p>Location: England.</p> <p>Enrolment: 400 (200 from each area).</p> <p>Inclusion criteria: women attending for antenatal care in a 2 UK hospitals with a BMI 30 kg/m² or greater.</p> <p>Exclusion criteria: aged under 18, intend to move in the next 3 months, take weight control medication or if they have any cautions for starting exercise (this will be determined using the Revised Physical Activity Readiness Questionnaire (PARQ) and the Royal College of Obstetricians and Gynaecologists (RCOG) recommendations).</p>
Interventions	<p>The lifestyle programme will run for 1.5 hours per week for 10 weeks and is supplementary to standard antenatal care. Women will be invited to the 10-week programme at any stage before 30 weeks' gestation to ensure completion of the programme before their delivery.</p> <p>The control group will receive routine care.</p>
Outcomes	<p>Primary outcomes: pregnancy weight gain, birthweight, mode of birth, and method of infant feeding at hospital discharge: psychological outcomes include self-efficacy, well-being, and goal attainment.</p> <p>Secondary outcomes: women's experience of pregnancy and healthcare services, amount of physical activity, food intake, and the suitability of the intervention components.</p>
Starting date	October 2011 (recruitment).
Contact information	<p>Professor Tina Lavender; tina.lavender@manchester.ac.uk</p> <p>University of Manchester, Oxford Road, Manchester. M13 9PL</p> <p>United Kingdom.</p>

Smith 2010 (Continued)

Notes Publication pending (personal communication on 25/9/14).

Thangaratinam 2014

Trial name or title	Effect of simple, targeted diet in pregnant women with metabolic risk factors on pre-eclampsia (ESTEEM): a randomised trial.
Methods	RCT, location: United Kingdom.
Participants	<p>3640 pregnant women.</p> <p>Inclusion criteria: pregnant women less than 18 weeks of gestation with at least 1 of the following: i. BMI ≥ 30 kg/m² ii. Raised serum triglycerides ≥ 1.7 mmol/L iii. Raised blood pressure of systole ≥ 140 mm Hg or diastole ≥ 90 mm Hg.</p> <p>Exclusion criteria: i. BMI < 18.5 kg/m² or ≥ 40 kg/m² ii. Women on lipid altering drugs iii. History of diabetes iv. Chronic renal disease v. Auto immune disease vi. Multiple pregnancy vii. Poor understanding of written and spoken English viii. Not able to follow Mediterranean diet for religious or other reasons ix. < 16 years of age x. Not able to consume nuts or extra virgin olive oil.</p>
Interventions	<p>Behavioural: targeted ESTEEM diet. The key components of the diet are:</p> <p>High intake of vegetables, nuts, non-refined grains, legumes and fruits; moderate-to-high consumption of fish; small-to-moderate intake of poultry and dairy products such as yoghurt and cheese; low consumption of red meat and processed meat and avoidance of sugary drinks, fast food and high fat food; high fibre; intake of nuts including walnuts and almonds that are rich sources of monounsaturated and polyunsaturated fatty acids (30 g/day); olive oil to cook and dress salads as the main source of fat (0.5 L/week).</p> <p>The intervention will include structured meal plans and grocery lists, recipes for healthy diet and appropriate choices at restaurants.</p>
Outcomes	<p>Number of participants with a diagnosis of pre-eclampsia.</p> <p>Diagnosis of pre-eclampsia defined as: new onset hypertension after 20 weeks' gestation defined as SBP ≥ 140 mm Hg or DBP ≥ 90 mmHg, in at least 2 readings AND new onset proteinuria defined as spot urine.</p> <p>Protein/creatinine ratio test greater than 30 mg/mmol or > 24-hour urine 300 mg/24 hours or 2+ or more on standard urinary dipstick tests after 20 weeks' gestation.</p> <p>Superimposed pre-eclampsia in women with chronic hypertension or chronic proteinuria.</p> <p>Women with eclamptic seizures with no hypertension or proteinuria.</p>
Starting date	July 2014.
Contact information	Shakila Thangaratinam, s.thangaratinam@qmul.ac.uk
Notes	Estimated primary completion date: February 2016.

Thomson 2014

Trial name or title	Delta Healthy Sprouts: a randomised comparative effectiveness trial to promote maternal weight control and reduce childhood obesity in the Mississippi Delta.
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Thomson 2014 (Continued)

Methods	Parallel arm RCT. Location: USA.
Participants	150 mothers and their infants residing in the rural Mississippi Delta who are in their second trimester and are < 19 weeks pregnant with first, second or third child, > 18 years of age between 14 and 18 weeks' gestation. Excluded if multiple pregnancy.
Interventions	Nutrition and PA counselling (monthly PaT lessons and materials and PaTE supplemental nutrition and physical activity lessons and materials) vs monthly PaT lessons and materials only.
Outcomes	Primary: mothers: GWG, BMI. Infants: weight-for-length. Secondary; diet, diet quality, physical activity, knowledge, beliefs, and practices.
Starting date	January 2013.
Contact information	Jessica L Thomson, jessica.thomson@ars.usda.gov, United States Department of Agriculture/University of Illinois at Chicago and University of Illinois Cancer Centre.
Notes	

Uauy 2013

Trial name or title	Effectiveness of a normative intervention (diet, physical activity and breastfeeding) on maternal nutrition and offspring growth and development: nutrition in the first 1000 days key to healthy growth and long-term health.
Methods	Cluster-RCT, multicentre, single group, double blind (investigator, outcomes assessor). Location: Chile.
Participants	2400 pregnant women before 15 weeks of pregnancy who are not planning to move in the next 2 years. Excluded if women were classified as high risk according to the norms of the Chilean Ministry of Health (MoH) and/or underweight (BMI < 18.5).
Interventions	Diet and physical activity counselling-support and breastfeeding promotion till 12 months postpartum vs routine care.
Outcomes	GWG, glycaemic control, weight retention at 12 months, infant growth.
Starting date	01/09/2013.
Contact information	Maria L Garmendia, PhD, mgarmendia@inta.uchile.cl, University of Chile.
Notes	Estimated completion date: March 2017.

Vistad 2009

Trial name or title	Fit For Delivery: a study of the effect of exercise intervention and nutritional counselling on pregnancy outcome.
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Vistad 2009 (Continued)

Methods	RCT, parallel, single blinded (investigator). Location: Norway.
Participants	600 pregnant women expecting first child who reside in 1 of the following towns: Kristiansand, Søgne, Sogndalen, Vennesla, Lillesand, Mandal, in their gestational weeks 12-20. Excluded if twin or other multiple pregnancy, pre-existing diabetes, physical handicap which precludes participation in exercise groups, ongoing drug addiction, serious mental disorder, BMI at or below 19 before pregnancy, inability to read/write Norwegian or English.
Interventions	Diet counselling (2 telephone consultations on nutritional health and access to Internet topics) and twice weekly exercise groups vs routine pregnancy care.
Outcomes	GWG, birthweight, maternal fasting serum glucose level, incidence of operative delivery, both caesarean section and operative vaginal delivery, maternal body composition. Secondary: maternal weight retention, measurement of serum levels of hormones which regulate serum glucose levels, in both the pregnant woman and her new-born baby, incidence of women with serum glucose levels >7.8 mmol/L after 2-hour glucose challenge test.
Starting date	01/09/2009.
Contact information	Ingvild Vistad, MD, PhD, no email mentioned, Sorland Hospital HF.
Notes	Estimated completion date: December 2014.

Yan 2012

Trial name or title	Low glycaemic index diet intervention on insulin resistance of overweight pregnant women.
Methods	RCT, parallel, single blind (participant). Location: China.
Participants	400 pregnant women with first prenatal examination BMI equal to or greater than 24 kg/m ² , singleton pregnancy, uniparous, 18 years to 45 years, ≥ 12 weeks' gestation. Excluded if artificial impregnation, history of hypertension, diabetes, coronary heart disease or mental disorder, special diet habit.
Interventions	Diet counselling (Dietary Guidelines for Chinese residents for pregnant women and low glycaemic index diet) vs standard diet counselling (diet counselling based on Dietary guidelines for Chinese Residents).
Outcomes	Maternal insulin, cord blood C-peptide, incidence of gestational diabetes, macrosomia. Secondary: incidence of gestational hypertension, proportion of women with newly incident hypertension during pregnancy, birthweight, caesarean delivery, gestational age.
Starting date	01/02/2012.
Contact information	Weili Yan, no email given, Fudan University.
Notes	November 2014 (final data collection date for primary outcome measure).

ACOG: the American Congress of Obstetricians and Gynecologists

BMI: body mass index

DBP: diastolic blood pressure

GDM: gestational diabetes mellitus
 GL: glycaemic load
 GWG: gestational weight gain
 HbA1c: haemoglobin A1c
 HDL: high density lipoprotein
 HIV: human immunodeficiency virus
 HTA: hydrothermal endometrial ablation
 IOM: Institute of Medicine
 LGA: large-for-gestational age
 MAMC: Madigan Army Medical Center
 OGTT: oral glucose tolerance test
 PA: physical activity
 QoL: quality of life
 RCT: randomised controlled trial
 SBP: systolic blood pressure
 SD: standard deviation
 SOCG: the Society of Obstetricians and Gynaecologists of Canada
 T2D: Type 2 diabetes
 WHO: World Health Organization

DATA AND ANALYSES

Comparison 1. All diet and/or exercise interventions vs standard/other care

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
1 Excessive weight gain	24	7096	Risk Ratio (M-H, Random, 95% CI)	0.80 [0.73, 0.87]
1.1 Diet intervention (low GI diet)	2	835	Risk Ratio (M-H, Random, 95% CI)	0.77 [0.66, 0.91]
1.2 Diet and exercise counselling	9	3144	Risk Ratio (M-H, Random, 95% CI)	0.86 [0.75, 0.98]
1.3 Unsupervised exercise	3	603	Risk Ratio (M-H, Random, 95% CI)	0.83 [0.71, 0.97]
1.4 Supervised exercise	3	1298	Risk Ratio (M-H, Random, 95% CI)	0.75 [0.63, 0.89]
1.5 Supervised exercise and diet	5	689	Risk Ratio (M-H, Random, 95% CI)	0.71 [0.59, 0.85]
1.6 Diet counselling/other	3	527	Risk Ratio (M-H, Random, 95% CI)	0.46 [0.17, 1.23]
2 Weight gain (kg)	36		Mean Difference (IV, Random, 95% CI)	Totals not selected
2.1 Diet intervention (low GI diet)	5		Mean Difference (IV, Random, 95% CI)	0.0 [0.0, 0.0]
2.2 Diet and exercise counselling	13		Mean Difference (IV, Random, 95% CI)	0.0 [0.0, 0.0]
2.3 Unsupervised exercise	1		Mean Difference (IV, Random, 95% CI)	0.0 [0.0, 0.0]

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
2.4 Supervised exercise intervention	7		Mean Difference (IV, Random, 95% CI)	0.0 [0.0, 0.0]
2.5 Supervised exercise plus diet intervention	3		Mean Difference (IV, Random, 95% CI)	0.0 [0.0, 0.0]
2.6 Diet counselling/other	7		Mean Difference (IV, Random, 95% CI)	0.0 [0.0, 0.0]
3 Low weight gain	11	4422	Risk Ratio (M-H, Random, 95% CI)	1.14 [1.02, 1.27]
3.1 Diet intervention (low GI diet)	1	87	Risk Ratio (M-H, Random, 95% CI)	1.24 [0.64, 2.43]
3.2 Diet and exercise counselling	5	2552	Risk Ratio (M-H, Random, 95% CI)	1.25 [0.90, 1.75]
3.3 Unsupervised exercise	3	603	Risk Ratio (M-H, Random, 95% CI)	1.13 [0.80, 1.60]
3.4 Supervised exercise	1	962	Risk Ratio (M-H, Random, 95% CI)	1.21 [0.99, 1.48]
3.5 Supervised exercise plus diet	1	49	Risk Ratio (M-H, Random, 95% CI)	1.47 [0.40, 5.50]
3.6 Diet counselling/other	1	169	Risk Ratio (M-H, Random, 95% CI)	1.21 [0.80, 1.82]
4 Preterm birth	16	5923	Risk Ratio (M-H, Random, 95% CI)	0.91 [0.68, 1.22]
4.1 Diet intervention (low GI diet)	2	804	Risk Ratio (M-H, Random, 95% CI)	0.33 [0.11, 1.02]
4.2 Diet and exercise counselling	7	3170	Risk Ratio (M-H, Random, 95% CI)	0.95 [0.60, 1.51]
4.3 Unsupervised exercise	2	229	Risk Ratio (M-H, Random, 95% CI)	1.17 [0.35, 3.85]
4.4 Supervised exercise	3	1129	Risk Ratio (M-H, Random, 95% CI)	1.92 [0.75, 4.93]
4.5 Diet counselling/other	3	591	Risk Ratio (M-H, Random, 95% CI)	0.67 [0.26, 1.73]
5 Pre-eclampsia	15	5330	Risk Ratio (M-H, Random, 95% CI)	0.95 [0.77, 1.16]
5.1 Diet and exercise counselling	7	3139	Risk Ratio (M-H, Random, 95% CI)	0.99 [0.74, 1.31]
5.2 Supervised exercise	2	1024	Risk Ratio (M-H, Random, 95% CI)	0.91 [0.52, 1.60]
5.3 Unsupervised exercise	2	229	Risk Ratio (M-H, Random, 95% CI)	1.60 [0.38, 6.73]
5.4 Supervised exercise plus diet	1	304	Risk Ratio (M-H, Random, 95% CI)	0.84 [0.51, 1.40]
5.5 Diet counselling/other	4	634	Risk Ratio (M-H, Random, 95% CI)	0.90 [0.54, 1.48]

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
6 Hypertension (not prespecified)	11	5162	Risk Ratio (M-H, Random, 95% CI)	0.70 [0.51, 0.96]
6.1 Diet and exercise counselling	5	2648	Risk Ratio (M-H, Random, 95% CI)	0.84 [0.54, 1.29]
6.2 Unsupervised exercise	2	229	Risk Ratio (M-H, Random, 95% CI)	0.43 [0.12, 1.54]
6.3 Supervised exercise	3	1749	Risk Ratio (M-H, Random, 95% CI)	0.55 [0.29, 1.03]
6.4 Supervised exercise plus diet	1	304	Risk Ratio (M-H, Random, 95% CI)	0.84 [0.51, 1.40]
6.5 Diet counselling/other	1	232	Risk Ratio (M-H, Random, 95% CI)	0.30 [0.08, 1.06]
7 Induction of labour	8	3832	Risk Ratio (M-H, Random, 95% CI)	1.06 [0.94, 1.19]
7.1 Diet intervention (low GI diet)	1	734	Risk Ratio (M-H, Random, 95% CI)	1.64 [1.14, 2.36]
7.2 Diet and exercise counselling	4	2522	Risk Ratio (M-H, Random, 95% CI)	1.03 [0.93, 1.14]
7.3 Unsupervised exercise	1	192	Risk Ratio (M-H, Random, 95% CI)	0.98 [0.65, 1.48]
7.4 Supervised exercise	1	35	Risk Ratio (M-H, Random, 95% CI)	0.32 [0.01, 7.26]
7.5 Diet counselling/other	2	349	Risk Ratio (M-H, Random, 95% CI)	0.89 [0.59, 1.35]
8 Caesarean delivery	28	7534	Risk Ratio (M-H, Random, 95% CI)	0.95 [0.88, 1.03]
8.1 Diet intervention (low GI diet)	2	133	Risk Ratio (M-H, Random, 95% CI)	0.99 [0.33, 3.01]
8.2 Diet and exercise counselling	9	3406	Risk Ratio (M-H, Random, 95% CI)	0.87 [0.75, 1.01]
8.3 Unsupervised exercise intervention	2	229	Risk Ratio (M-H, Random, 95% CI)	0.91 [0.53, 1.59]
8.4 Supervised exercise	8	2405	Risk Ratio (M-H, Random, 95% CI)	0.96 [0.82, 1.11]
8.5 Supervised exercise plus diet	3	607	Risk Ratio (M-H, Random, 95% CI)	1.00 [0.69, 1.45]
8.6 Diet counselling/other	5	754	Risk Ratio (M-H, Random, 95% CI)	1.06 [0.93, 1.21]
9 Postpartum weight retention (kg)	7	818	Mean Difference (IV, Random, 95% CI)	-1.12 [-2.49, 0.25]
9.1 Diet intervention (low GI diet)	1	414	Mean Difference (IV, Random, 95% CI)	-1.40 [-2.63, -0.17]
9.2 Diet and exercise counselling	2	188	Mean Difference (IV, Random, 95% CI)	-1.13 [-4.88, 2.61]

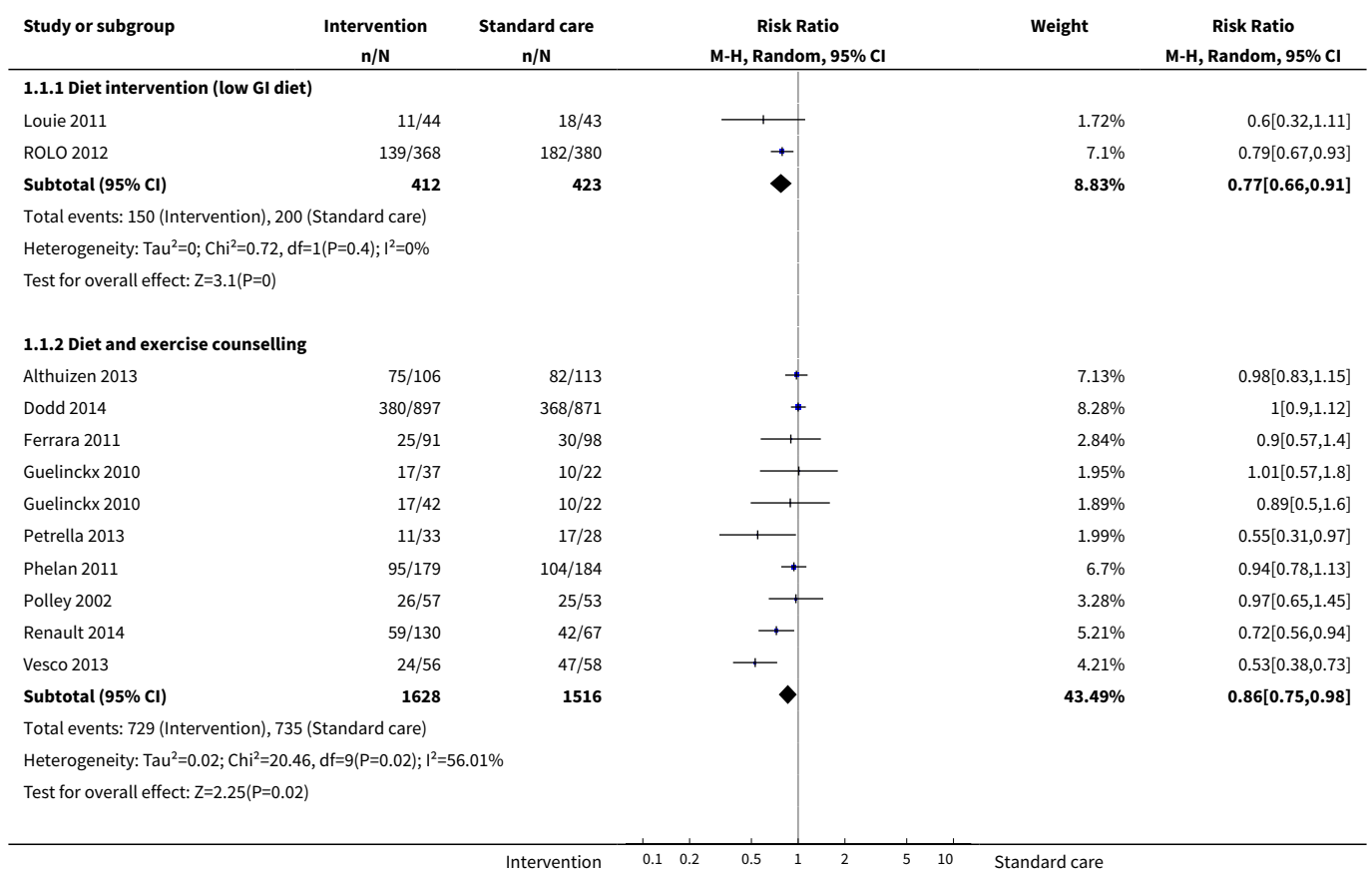
Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
9.3 Supervised exercise	2	132	Mean Difference (IV, Random, 95% CI)	0.17 [-1.61, 1.96]
9.4 Supervised exercise plus diet	1	49	Mean Difference (IV, Random, 95% CI)	-0.80 [-2.84, 1.24]
9.5 Diet counselling/other	1	35	Mean Difference (IV, Random, 95% CI)	-6.9 [-15.28, 1.48]
10 Postpartum weight retention (n/N; investigator defined time frame)	5	902	Risk Ratio (M-H, Random, 95% CI)	0.78 [0.63, 0.97]
10.1 Diet and exercise counselling	3	615	Risk Ratio (M-H, Random, 95% CI)	0.72 [0.51, 1.01]
10.2 Supervised exercise plus diet intervention	2	287	Risk Ratio (M-H, Random, 95% CI)	0.85 [0.66, 1.10]
11 Energy intake (kj)	12	4065	Mean Difference (IV, Random, 95% CI)	-570.77 [-894.28, -247.26]
11.1 Diet intervention (low GI diet)	4	1462	Mean Difference (IV, Random, 95% CI)	-297.26 [-562.80, -31.72]
11.2 Diet and exercise counselling	4	2190	Mean Difference (IV, Random, 95% CI)	-897.66 [-1763.09, -32.23]
11.3 Supervised exercise plus diet intervention	3	274	Mean Difference (IV, Random, 95% CI)	-1090.80 [-2263.86, 82.26]
11.4 Diet counselling/other	1	139	Mean Difference (IV, Random, 95% CI)	-172.0 [-686.85, 342.85]
12 Fibre intake (g)	8	3466	Mean Difference (IV, Random, 95% CI)	1.53 [0.94, 2.12]
12.1 Diet intervention (low GI diet)	4	1223	Mean Difference (IV, Random, 95% CI)	1.35 [0.55, 2.15]
12.2 Diet and exercise counselling	2	1996	Mean Difference (IV, Random, 95% CI)	1.97 [0.95, 2.99]
12.3 Supervised exercise plus diet intervention	1	112	Mean Difference (IV, Random, 95% CI)	1.0 [-3.06, 5.06]
12.4 Diet counselling//other	1	135	Mean Difference (IV, Random, 95% CI)	1.10 [-0.91, 3.11]
13 Physical activity score (26-29 weeks)	9	2851	Std. Mean Difference (IV, Random, 95% CI)	0.40 [0.18, 0.61]
13.1 Diet and exercise counselling	5	2395	Std. Mean Difference (IV, Random, 95% CI)	0.27 [0.03, 0.51]

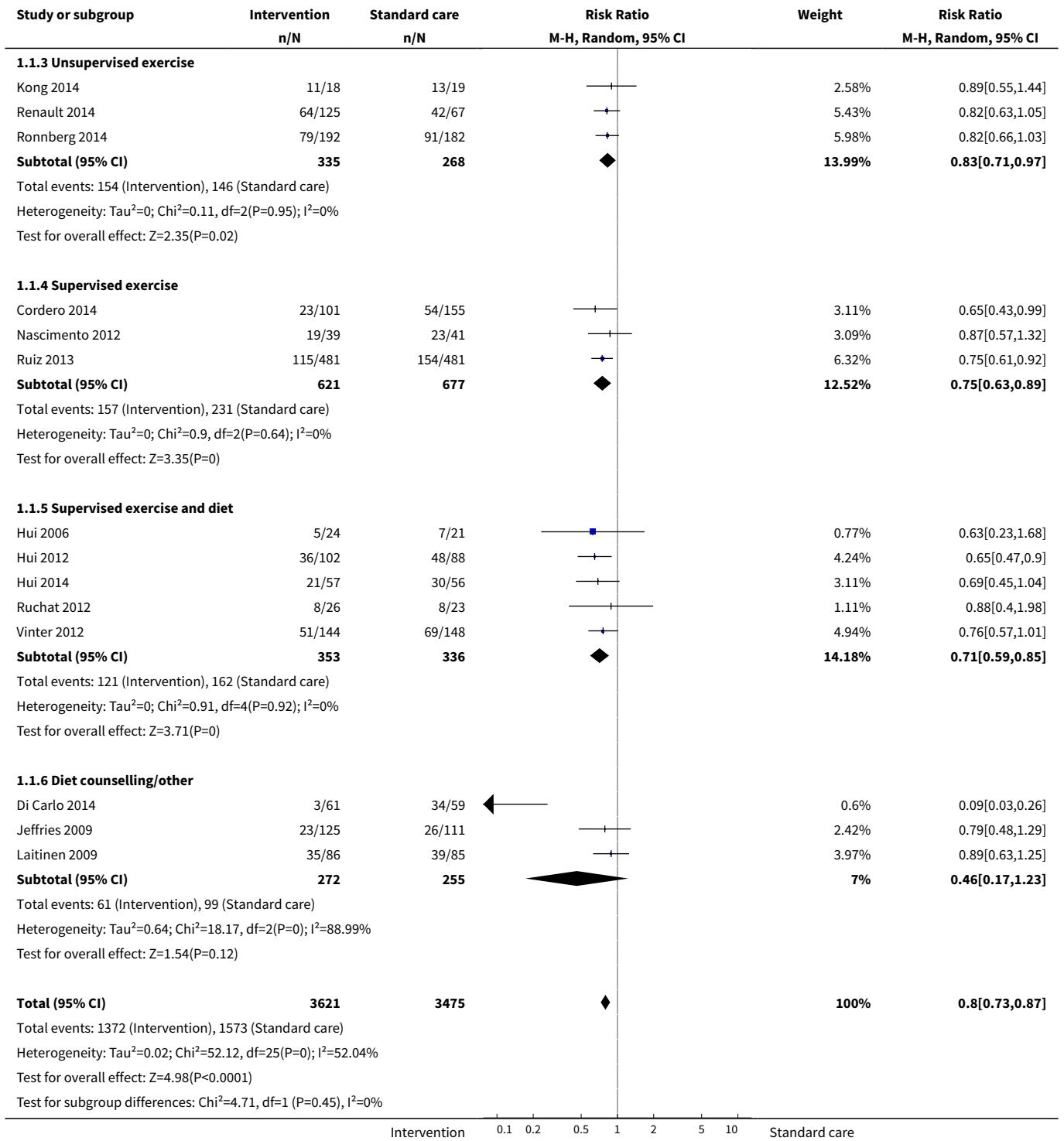
Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
13.2 Supervised exercise intervention	2	232	Std. Mean Difference (IV, Random, 95% CI)	0.43 [0.06, 0.79]
13.3 Supervised exercise plus diet intervention	2	224	Std. Mean Difference (IV, Random, 95% CI)	0.73 [0.46, 1.00]
14 Macrosomia Infant birthweight > 4000 g	27	8598	Risk Ratio (M-H, Random, 95% CI)	0.93 [0.86, 1.02]
14.1 Diet intervention (low GI diet)	4	1472	Risk Ratio (M-H, Random, 95% CI)	0.96 [0.84, 1.10]
14.2 Diet and exercise counselling	10	3705	Risk Ratio (M-H, Random, 95% CI)	0.93 [0.77, 1.12]
14.3 Unsupervised exercise	2	229	Risk Ratio (M-H, Random, 95% CI)	1.16 [0.74, 1.81]
14.4 Supervised exercise intervention	7	2445	Risk Ratio (M-H, Random, 95% CI)	0.81 [0.64, 1.02]
14.5 Supervised exercise plus diet intervention	3	398	Risk Ratio (M-H, Random, 95% CI)	1.02 [0.71, 1.46]
14.6 Diet counselling/other	2	349	Risk Ratio (M-H, Random, 95% CI)	1.81 [0.88, 3.72]
15 Infant birthweight > 90th centile	18	4525	Risk Ratio (M-H, Random, 95% CI)	0.92 [0.80, 1.05]
15.1 Diet and exercise counselling	6	2777	Risk Ratio (M-H, Random, 95% CI)	0.87 [0.74, 1.02]
15.2 Unsupervised exercise	1	192	Risk Ratio (M-H, Random, 95% CI)	1.07 [0.34, 3.43]
15.3 Supervised exercise intervention	4	397	Risk Ratio (M-H, Random, 95% CI)	1.09 [0.59, 2.00]
15.4 Supervised exercise plus diet intervention	3	607	Risk Ratio (M-H, Random, 95% CI)	1.06 [0.67, 1.66]
15.5 Diet intervention (low GI diet)	3	200	Risk Ratio (M-H, Random, 95% CI)	1.25 [0.50, 3.11]
15.6 Diet counselling/other	2	352	Risk Ratio (M-H, Random, 95% CI)	0.95 [0.54, 1.69]
16 Birthweight (g) (not pre-specified)	29	8350	Mean Difference (IV, Random, 95% CI)	12.20 [-15.26, 39.65]
16.1 Diet intervention (low GI diet)	4	1447	Mean Difference (IV, Random, 95% CI)	-0.84 [-1.16, -0.52]
16.2 Diet and exercise counselling	9	3516	Mean Difference (IV, Random, 95% CI)	52.33 [-33.23, 137.89]
16.3 Unsupervised exercise	1	37	Mean Difference (IV, Random, 95% CI)	-124.21 [-435.86, 187.44]

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
16.4 Supervised exercise	11	2714	Mean Difference (IV, Random, 95% CI)	16.27 [-38.56, 71.11]
16.5 Supervised exercise and diet	1	49	Mean Difference (IV, Random, 95% CI)	-107.0 [-343.33, 129.33]
16.6 Diet counselling/other	3	587	Mean Difference (IV, Random, 95% CI)	1.40 [-78.04, 80.84]
17 Infant birthweight < 2500 g	12	4834	Risk Ratio (M-H, Random, 95% CI)	0.88 [0.67, 1.14]
17.1 Exercise and diet counselling	5	2934	Risk Ratio (M-H, Random, 95% CI)	0.84 [0.60, 1.17]
17.2 Unsupervised exercise	2	229	Risk Ratio (M-H, Random, 95% CI)	2.14 [0.24, 18.80]
17.3 Supervised exercise	4	1387	Risk Ratio (M-H, Random, 95% CI)	0.99 [0.61, 1.63]
17.4 Supervised exercise plus diet	1	49	Risk Ratio (M-H, Random, 95% CI)	2.67 [0.11, 62.42]
17.5 Diet counselling/other	1	235	Risk Ratio (M-H, Random, 95% CI)	0.67 [0.29, 1.53]
18 Infant birthweight < 10th centile	7	662	Risk Ratio (M-H, Random, 95% CI)	1.09 [0.61, 1.94]
18.1 Diet intervention (low GI diet)	2	155	Risk Ratio (M-H, Random, 95% CI)	1.49 [0.47, 4.71]
18.2 Diet and exercise counselling	2	207	Risk Ratio (M-H, Random, 95% CI)	0.95 [0.28, 3.29]
18.3 Supervised exercise	3	300	Risk Ratio (M-H, Random, 95% CI)	0.99 [0.45, 2.19]
19 Shoulder dystocia	4	3253	Risk Ratio (M-H, Random, 95% CI)	1.02 [0.57, 1.83]
19.1 Diet intervention (low GI diet)	1	759	Risk Ratio (M-H, Random, 95% CI)	0.52 [0.10, 2.82]
19.2 Diet and exercise counselling	1	2142	Risk Ratio (M-H, Random, 95% CI)	1.25 [0.81, 1.93]
19.3 Diet counselling/other	2	352	Risk Ratio (M-H, Random, 95% CI)	0.35 [0.05, 2.64]
20 Neonatal hypoglycaemia	4	2601	Risk Ratio (M-H, Random, 95% CI)	0.95 [0.76, 1.18]
20.1 Diet and exercise counselling	2	2256	Risk Ratio (M-H, Random, 95% CI)	1.02 [0.79, 1.32]
20.2 Diet counselling/other	2	345	Risk Ratio (M-H, Random, 95% CI)	0.88 [0.36, 2.15]
21 Birth trauma	2	2256	Risk Ratio (M-H, Random, 95% CI)	0.89 [0.35, 2.30]
21.1 Diet and exercise counselling	2	2256	Risk Ratio (M-H, Random, 95% CI)	0.89 [0.35, 2.30]

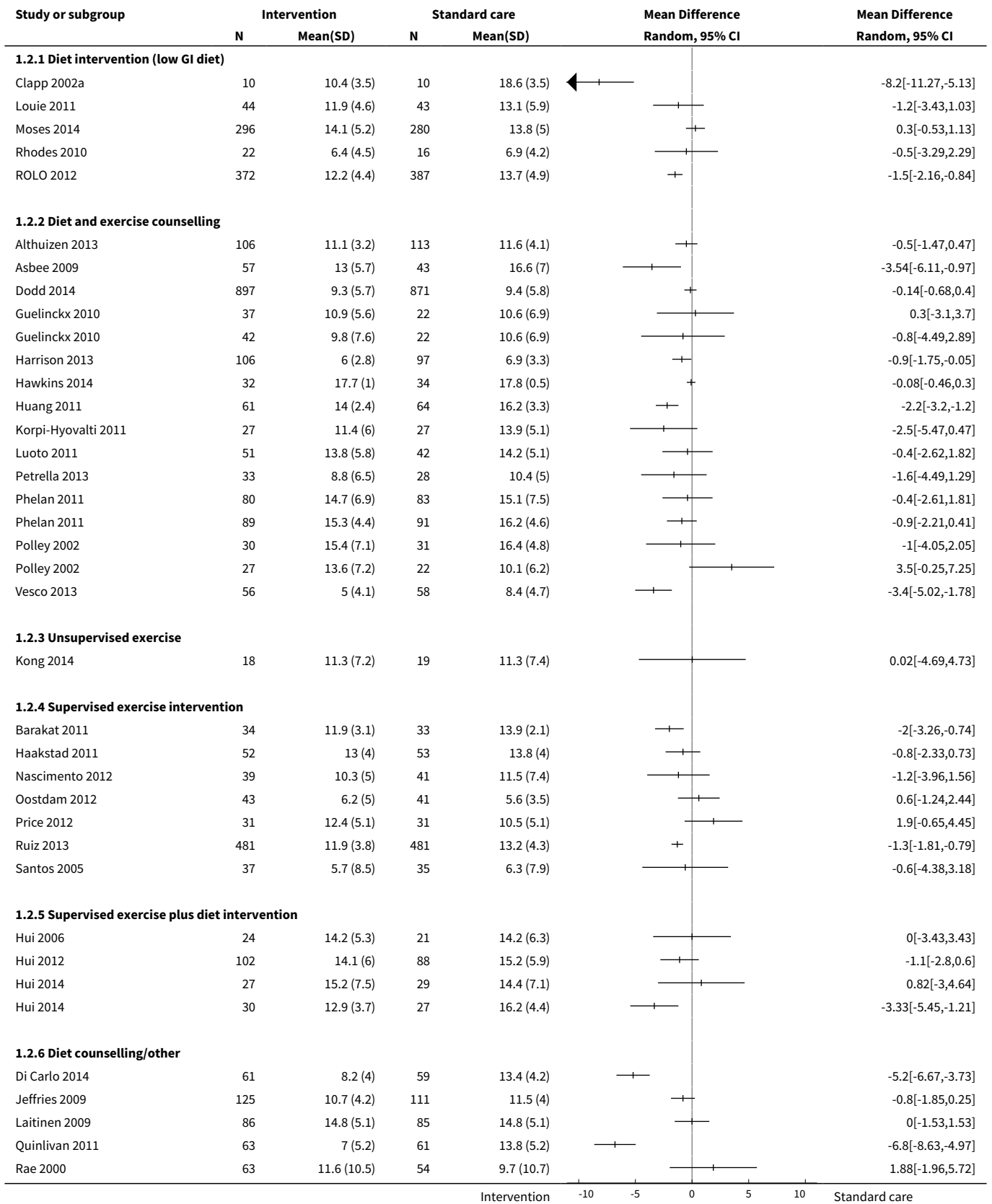
Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
22 Neonatal hyperbilirubinaemia	2	2256	Risk Ratio (M-H, Fixed, 95% CI)	0.83 [0.62, 1.10]
22.1 Diet and exercise counselling	2	2256	Risk Ratio (M-H, Fixed, 95% CI)	0.83 [0.62, 1.10]
23 Neonatal respiratory distress syndrome	2	2256	Risk Ratio (M-H, Random, 95% CI)	0.47 [0.26, 0.85]
23.1 Diet and exercise counselling	2	2256	Risk Ratio (M-H, Random, 95% CI)	0.47 [0.26, 0.85]
24 Postpartum hemorrhage	2	2901	Risk Ratio (M-H, Random, 95% CI)	0.94 [0.78, 1.14]
24.1 Diet intervention (low GL diet)	1	759	Risk Ratio (M-H, Random, 95% CI)	0.83 [0.23, 3.08]
24.2 Diet and exercise counselling	1	2142	Risk Ratio (M-H, Random, 95% CI)	0.94 [0.78, 1.14]

Analysis 1.1. Comparison 1 All diet and/or exercise interventions vs standard/other care, Outcome 1 Excessive weight gain.





Analysis 1.2. Comparison 1 All diet and/or exercise interventions vs standard/other care, Outcome 2 Weight gain (kg).



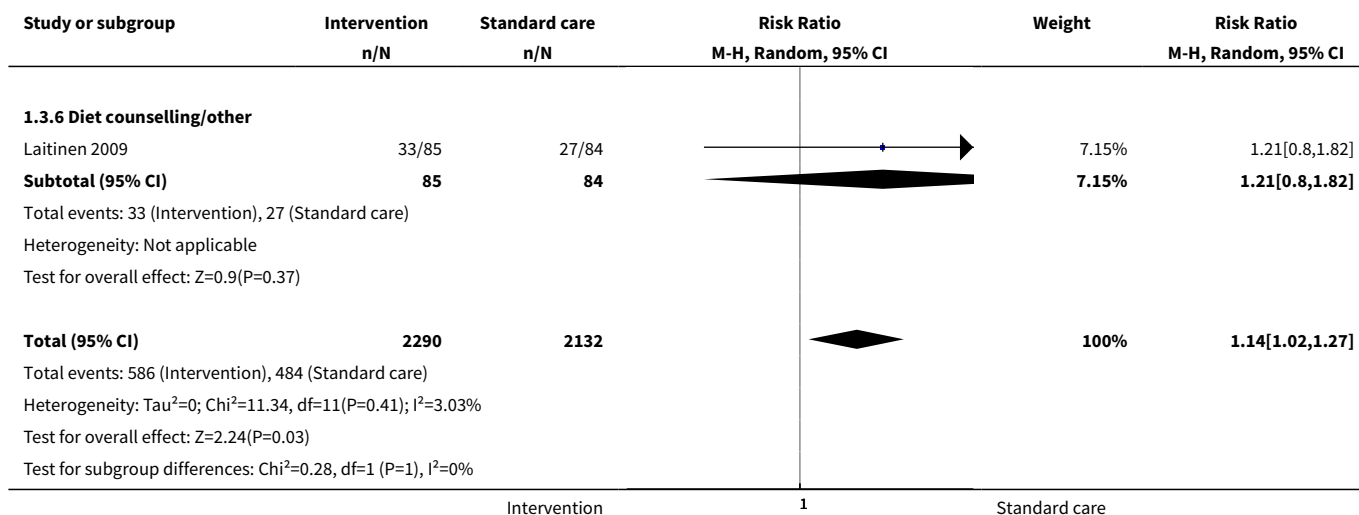
Study or subgroup	Intervention		Standard care		Mean Difference Random, 95% CI	Mean Difference Random, 95% CI
	N	Mean(SD)	N	Mean(SD)		
Thornton 2009	116	5 (6.8)	116	14.1 (7.4)		-9.07[-10.9,-7.24]
Wolff 2008	23	6.6 (5.5)	27	13.3 (7.5)		-6.7[-10.31,-3.09]

Intervention -10 -5 0 5 10 Standard care

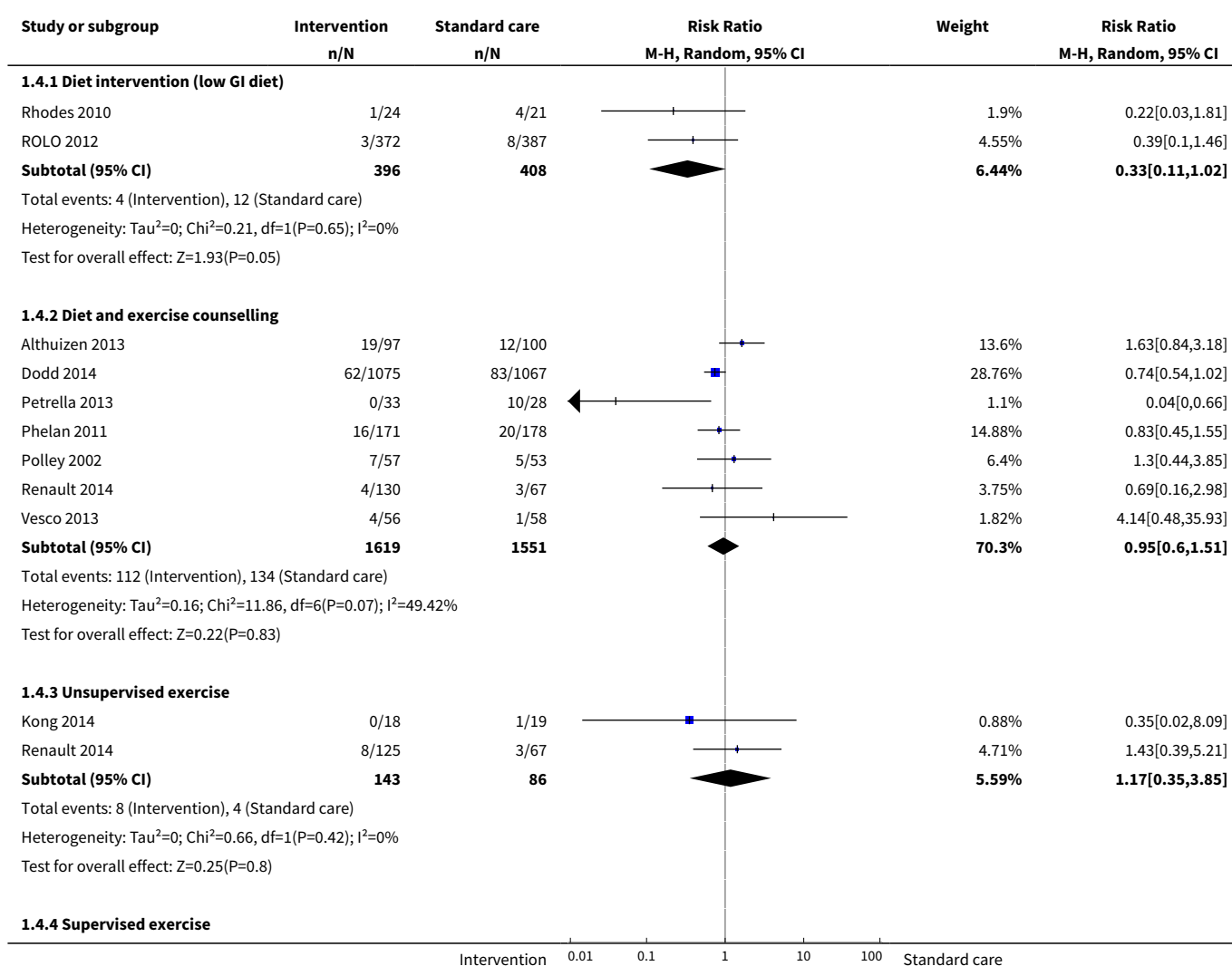
Analysis 1.3. Comparison 1 All diet and/or exercise interventions vs standard/other care, Outcome 3 Low weight gain.

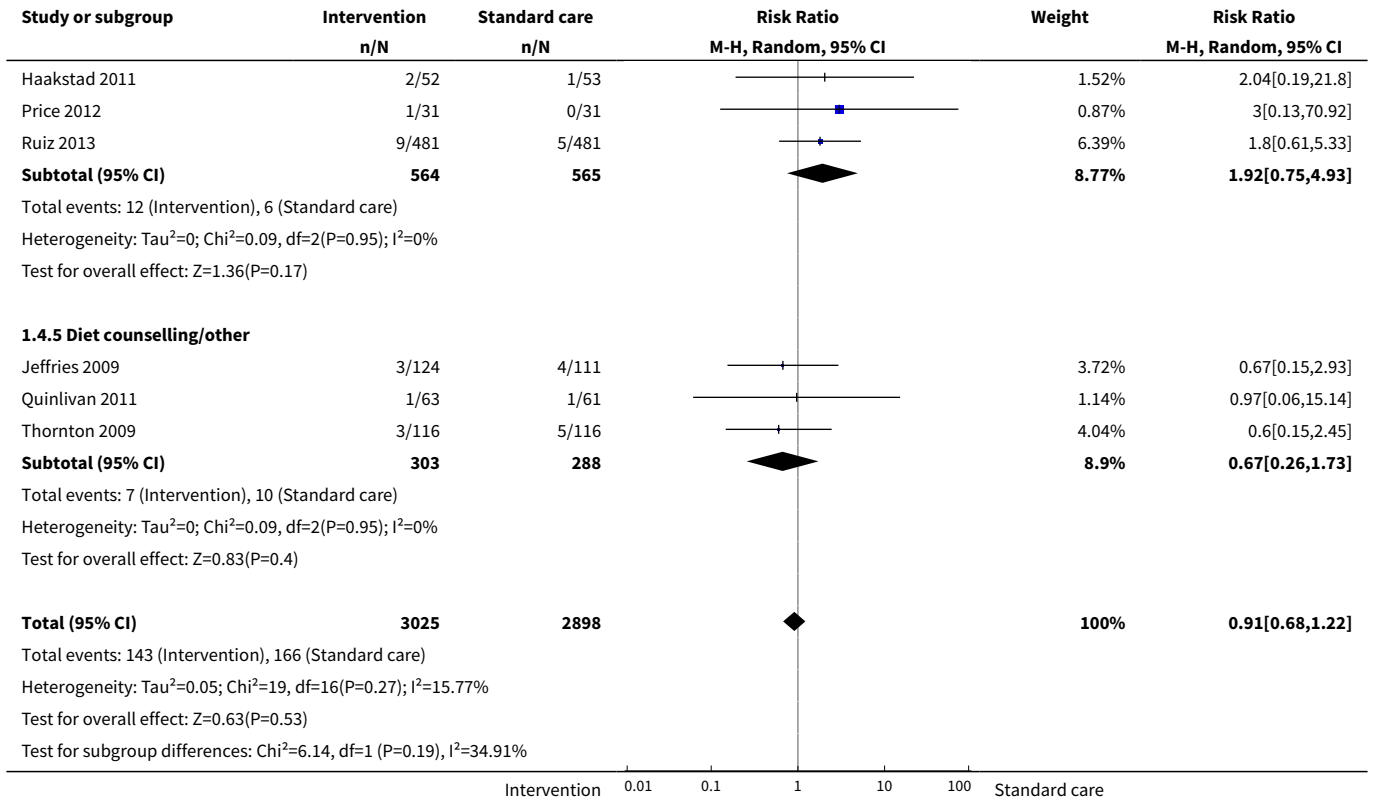
Study or subgroup	Intervention n/N	Standard care n/N	Risk Ratio M-H, Random, 95% CI	Weight	Risk Ratio M-H, Random, 95% CI
Louie 2011	14/44	11/43		2.74%	1.24[0.64,2.43]
Subtotal (95% CI)	44	43		2.74%	1.24[0.64,2.43]
Total events: 14 (Intervention), 11 (Standard care) Heterogeneity: Not applicable Test for overall effect: Z=0.64(P=0.52)					
1.3.2 Diet and exercise counselling					
Dodd 2014	224/897	217/871		39.48%	1[0.85,1.18]
Phelan 2011	24/179	24/184		4.37%	1.03[0.61,1.74]
Polley 2002	14/57	12/53		2.69%	1.08[0.55,2.13]
Renault 2014	34/130	12/67		3.52%	1.46[0.81,2.63]
Vesco 2013	21/56	7/58		2.05%	3.11[1.43,6.73]
Subtotal (95% CI)	1319	1233		52.11%	1.25[0.9,1.75]
Total events: 317 (Intervention), 272 (Standard care) Heterogeneity: Tau ² =0.07; Chi ² =9.07, df=4(P=0.06); I ² =55.9% Test for overall effect: Z=1.34(P=0.18)					
1.3.3 Unsupervised exercise					
Kong 2014	2/18	4/19		0.5%	0.53[0.11,2.54]
Renault 2014	28/125	12/67		3.3%	1.25[0.68,2.3]
Ronnberg 2014	36/192	30/182		6.22%	1.14[0.73,1.77]
Subtotal (95% CI)	335	268		10.03%	1.13[0.8,1.6]
Total events: 66 (Intervention), 46 (Standard care) Heterogeneity: Tau ² =0; Chi ² =1.01, df=2(P=0.6); I ² =0% Test for overall effect: Z=0.69(P=0.49)					
1.3.4 Supervised exercise					
Ruiz 2013	151/481	125/481		27.26%	1.21[0.99,1.48]
Subtotal (95% CI)	481	481		27.26%	1.21[0.99,1.48]
Total events: 151 (Intervention), 125 (Standard care) Heterogeneity: Not applicable Test for overall effect: Z=1.85(P=0.06)					
1.3.5 Supervised exercise plus diet					
Ruchat 2012	5/26	3/23		0.71%	1.47[0.4,5.5]
Subtotal (95% CI)	26	23		0.71%	1.47[0.4,5.5]
Total events: 5 (Intervention), 3 (Standard care) Heterogeneity: Not applicable Test for overall effect: Z=0.58(P=0.56)					

Intervention 1 Standard care

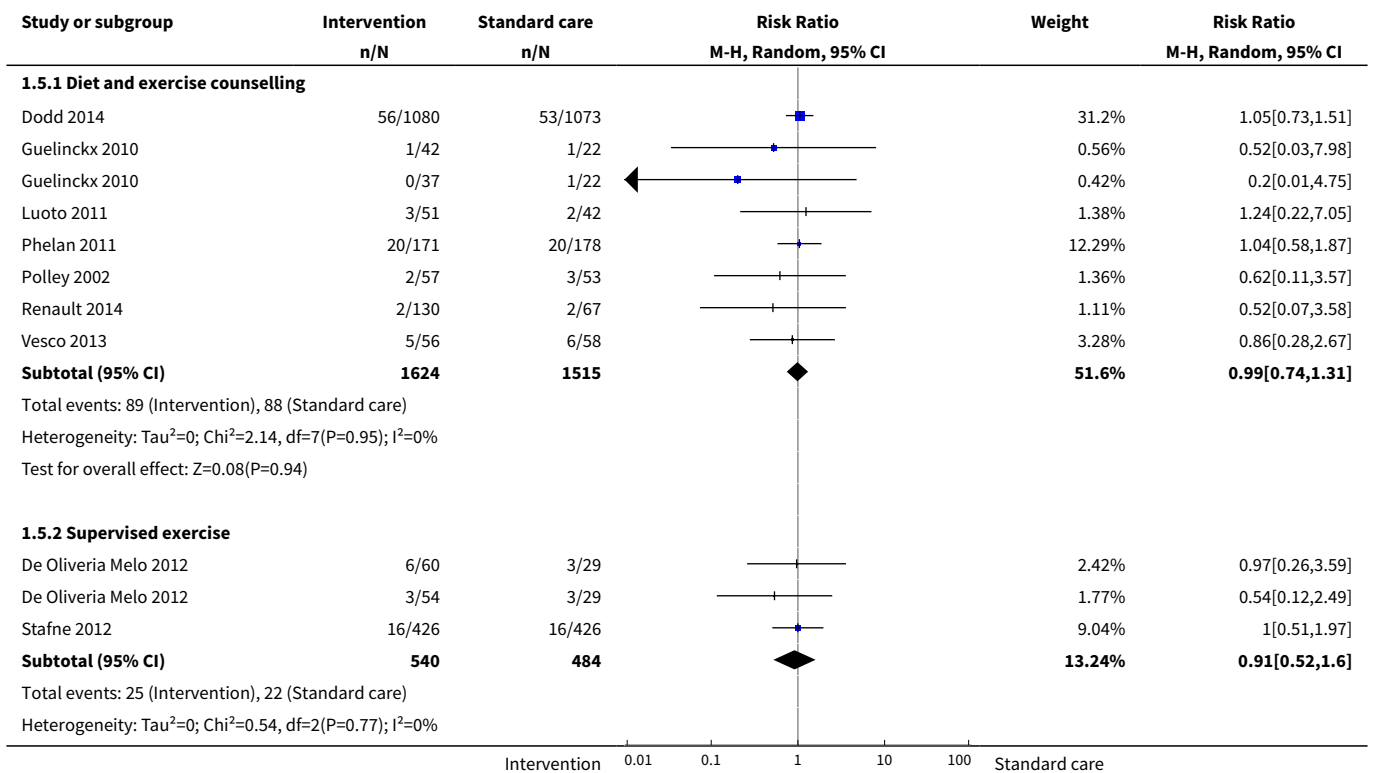


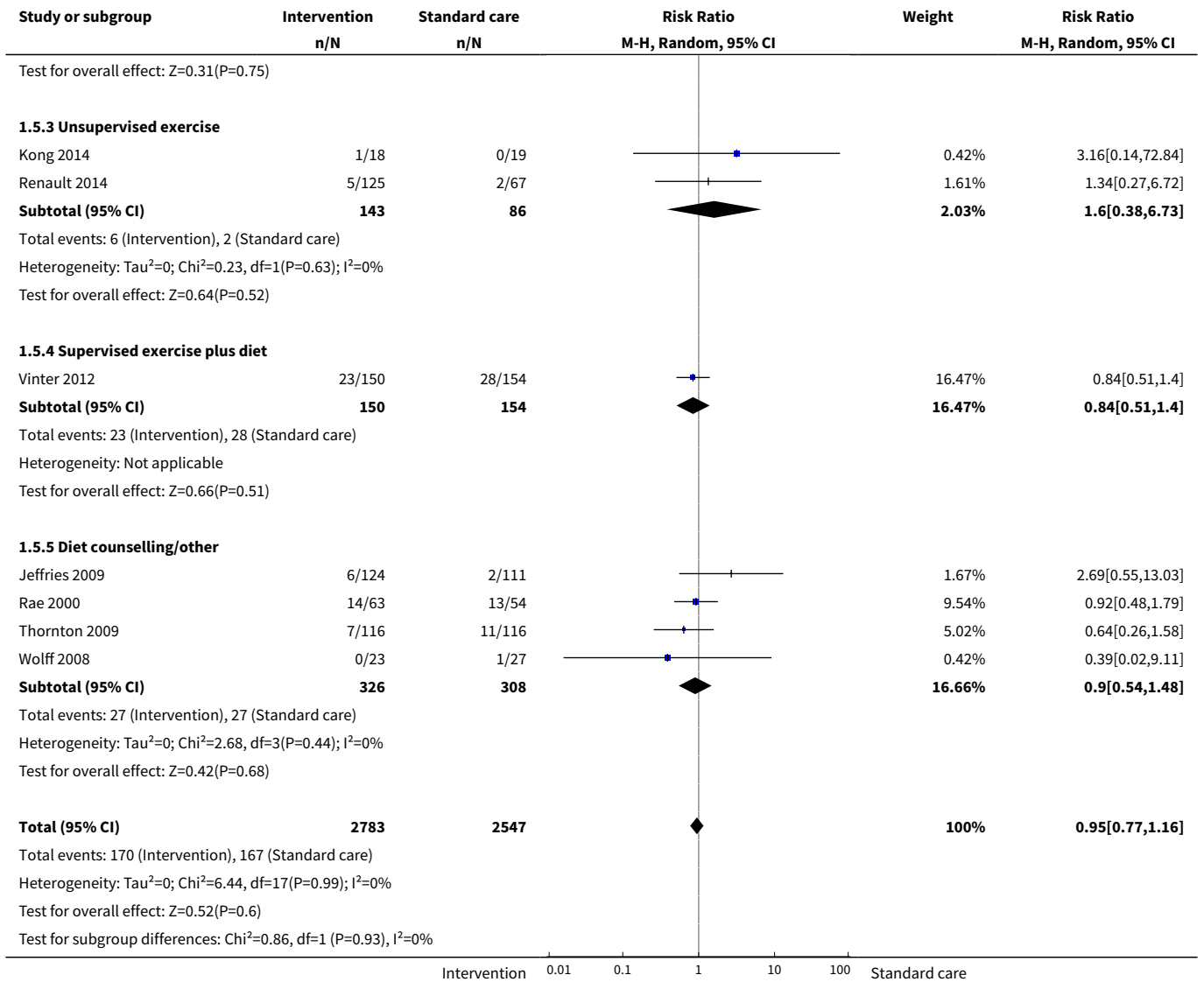
Analysis 1.4. Comparison 1 All diet and/or exercise interventions vs standard/other care, Outcome 4 Preterm birth.



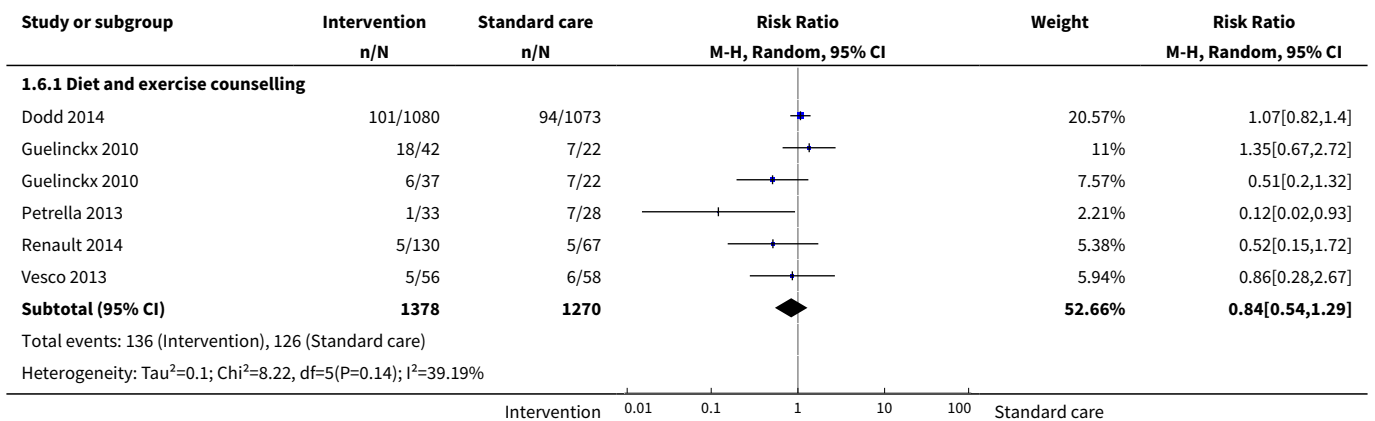


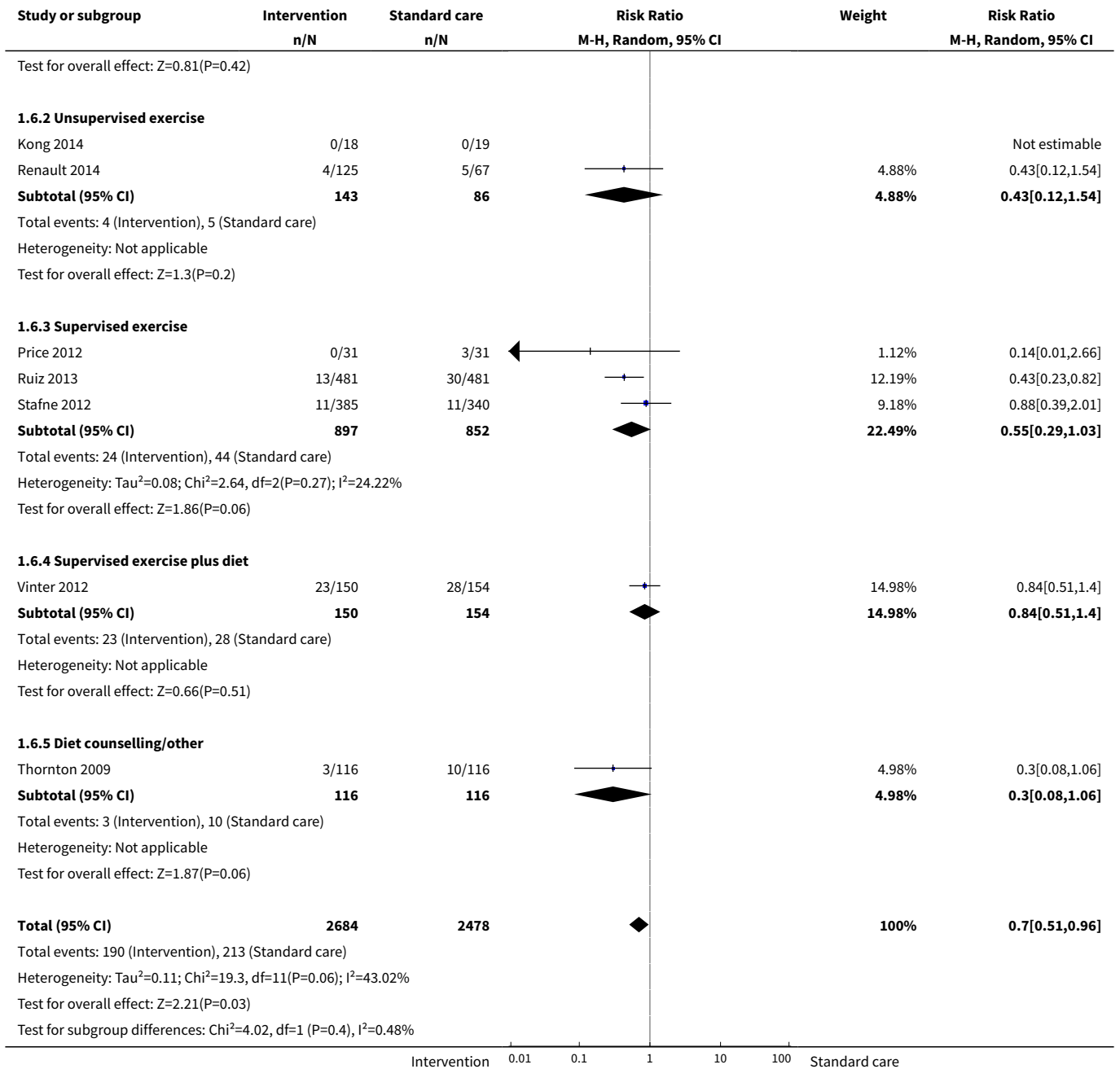
Analysis 1.5. Comparison 1 All diet and/or exercise interventions vs standard/other care, Outcome 5 Pre-eclampsia.



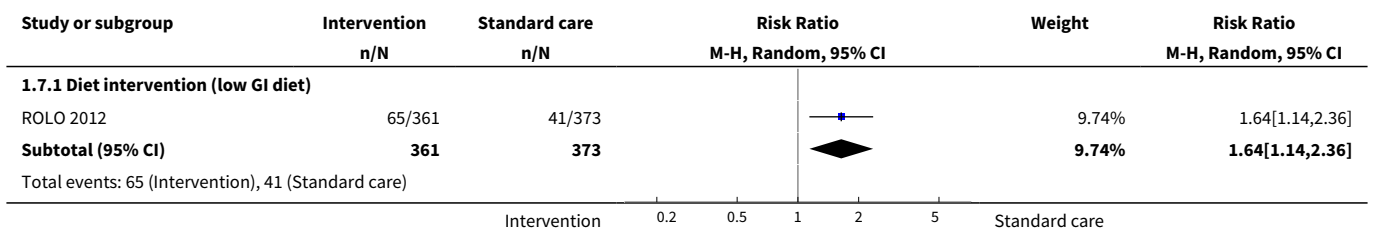


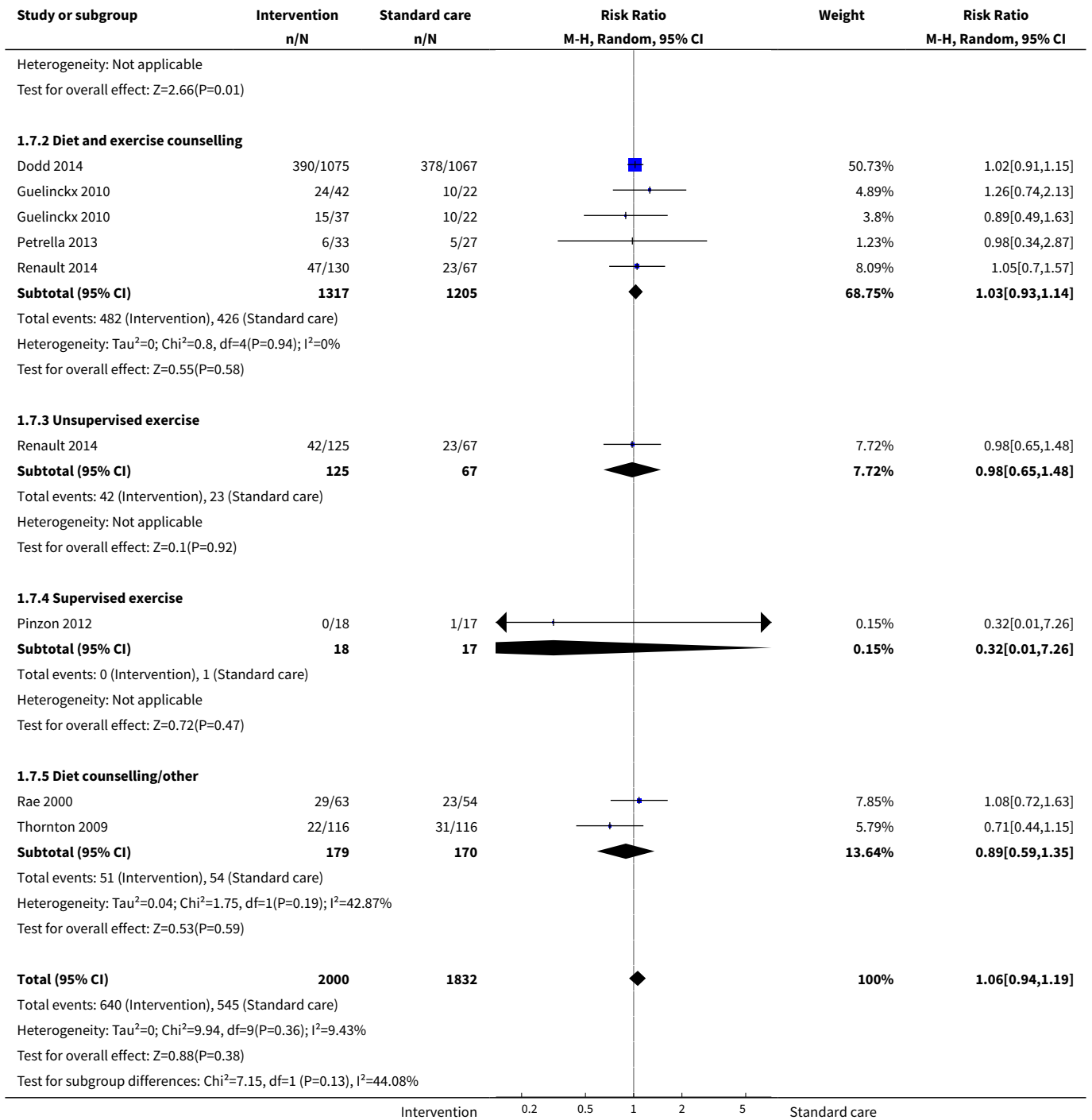
Analysis 1.6. Comparison 1 All diet and/or exercise interventions vs standard/other care, Outcome 6 Hypertension (not prespecified).



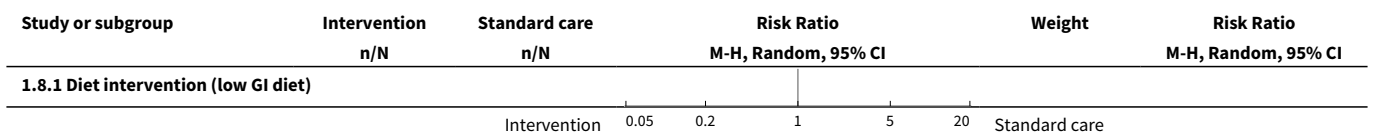


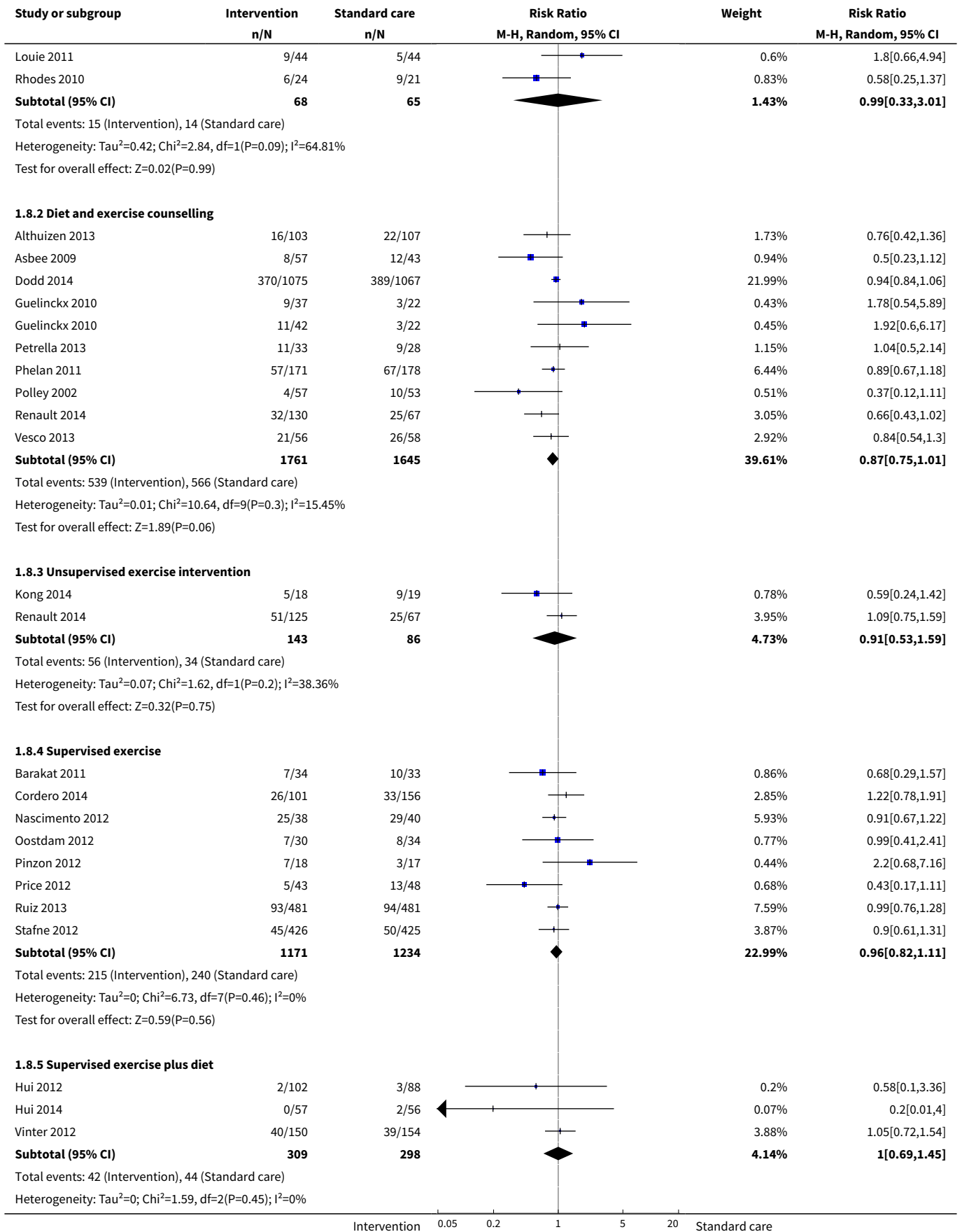
Analysis 1.7. Comparison 1 All diet and/or exercise interventions vs standard/other care, Outcome 7 Induction of labour.

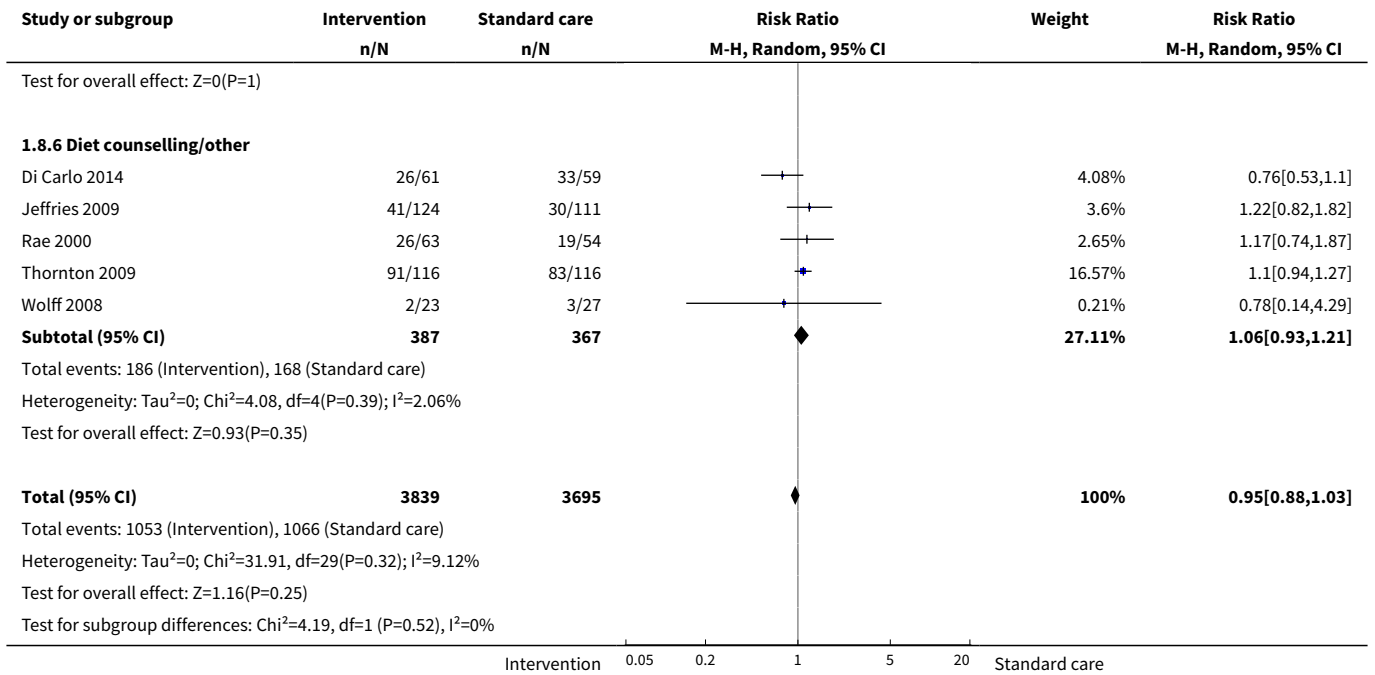




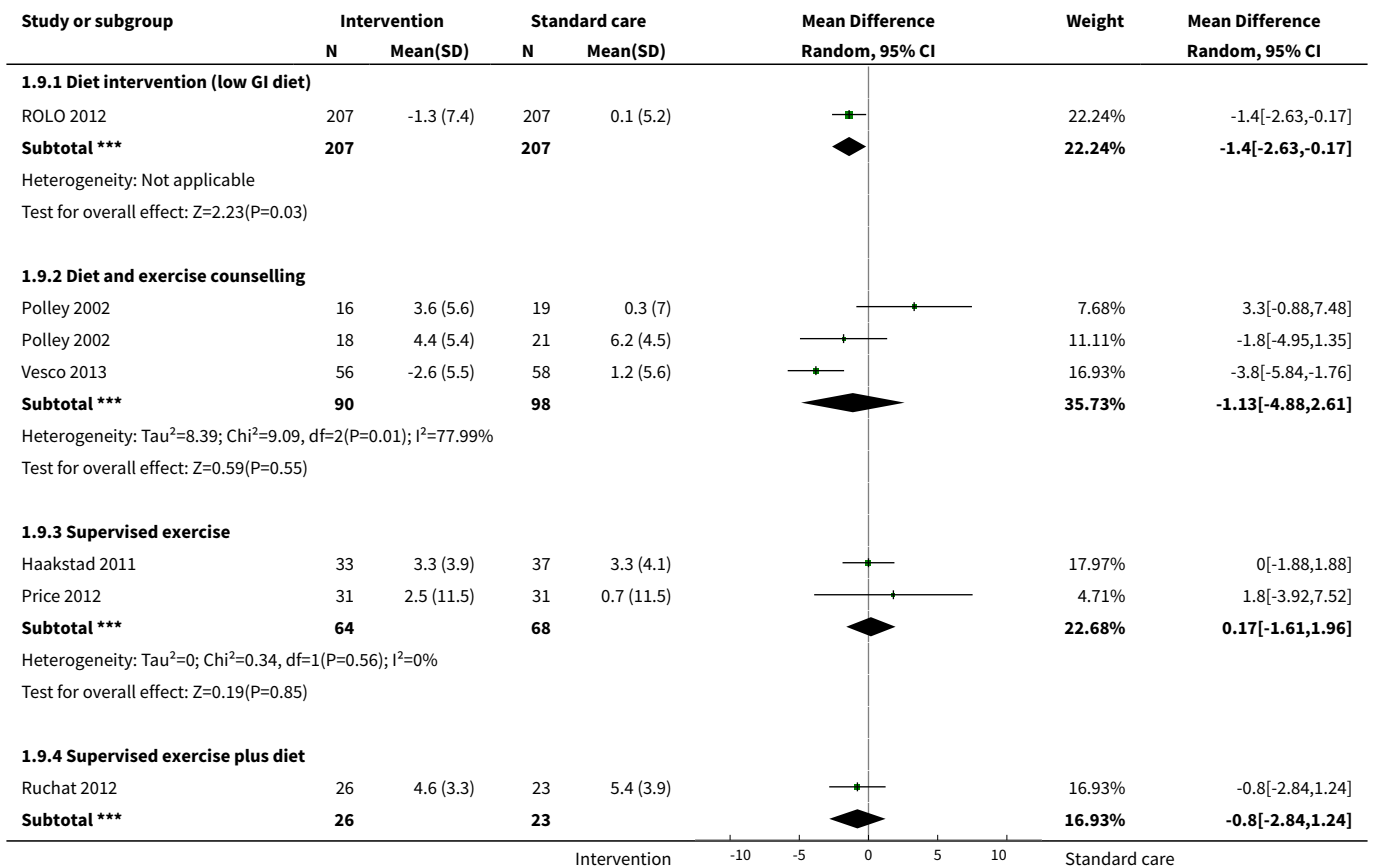
Analysis 1.8. Comparison 1 All diet and/or exercise interventions vs standard/other care, Outcome 8 Caesarean delivery.

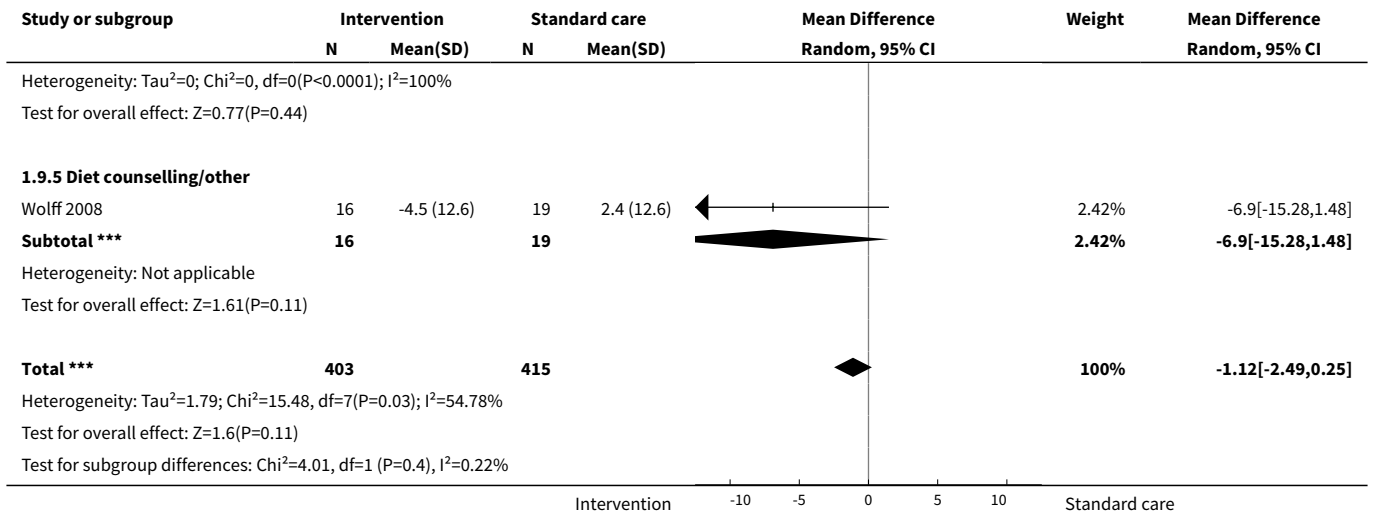




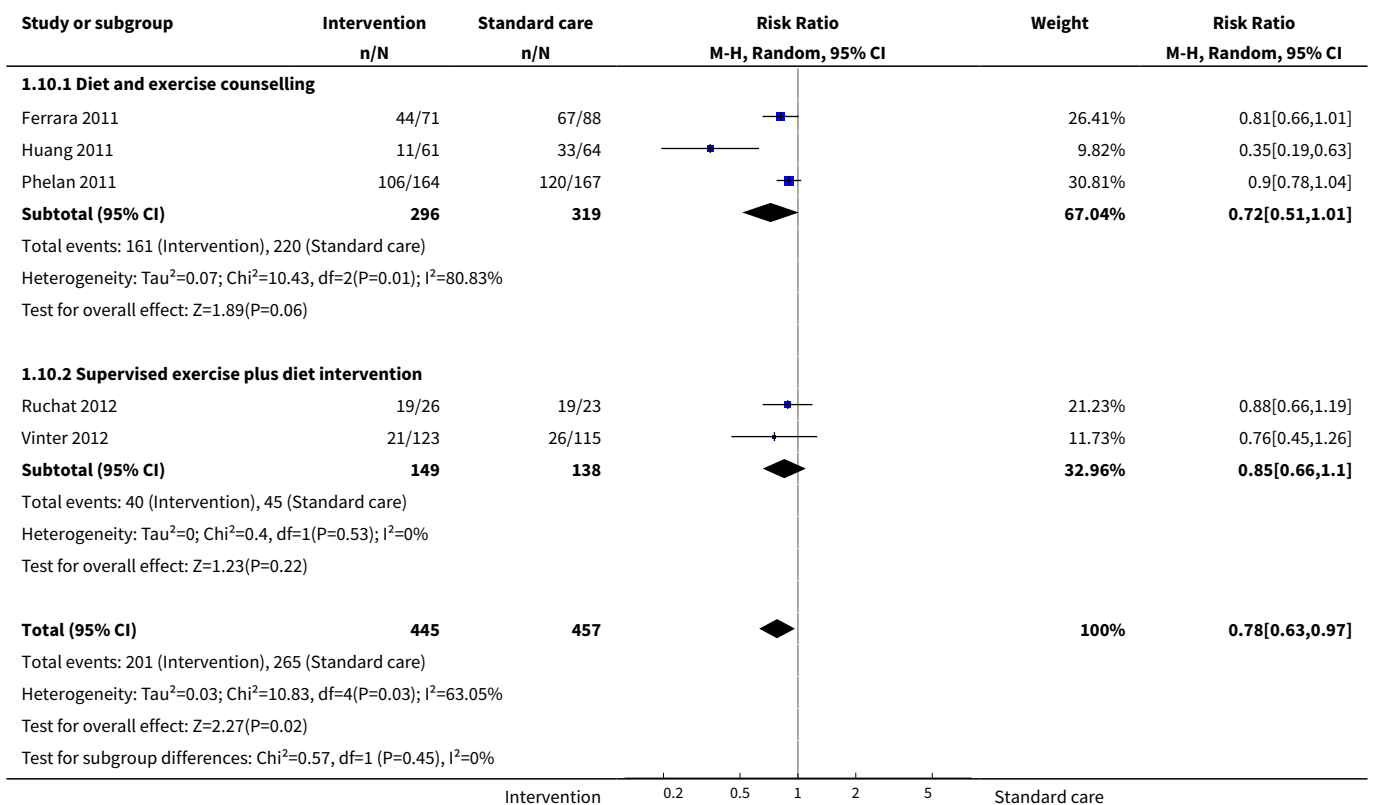


Analysis 1.9. Comparison 1 All diet and/or exercise interventions vs standard/other care, Outcome 9 Postpartum weight retention (kg).

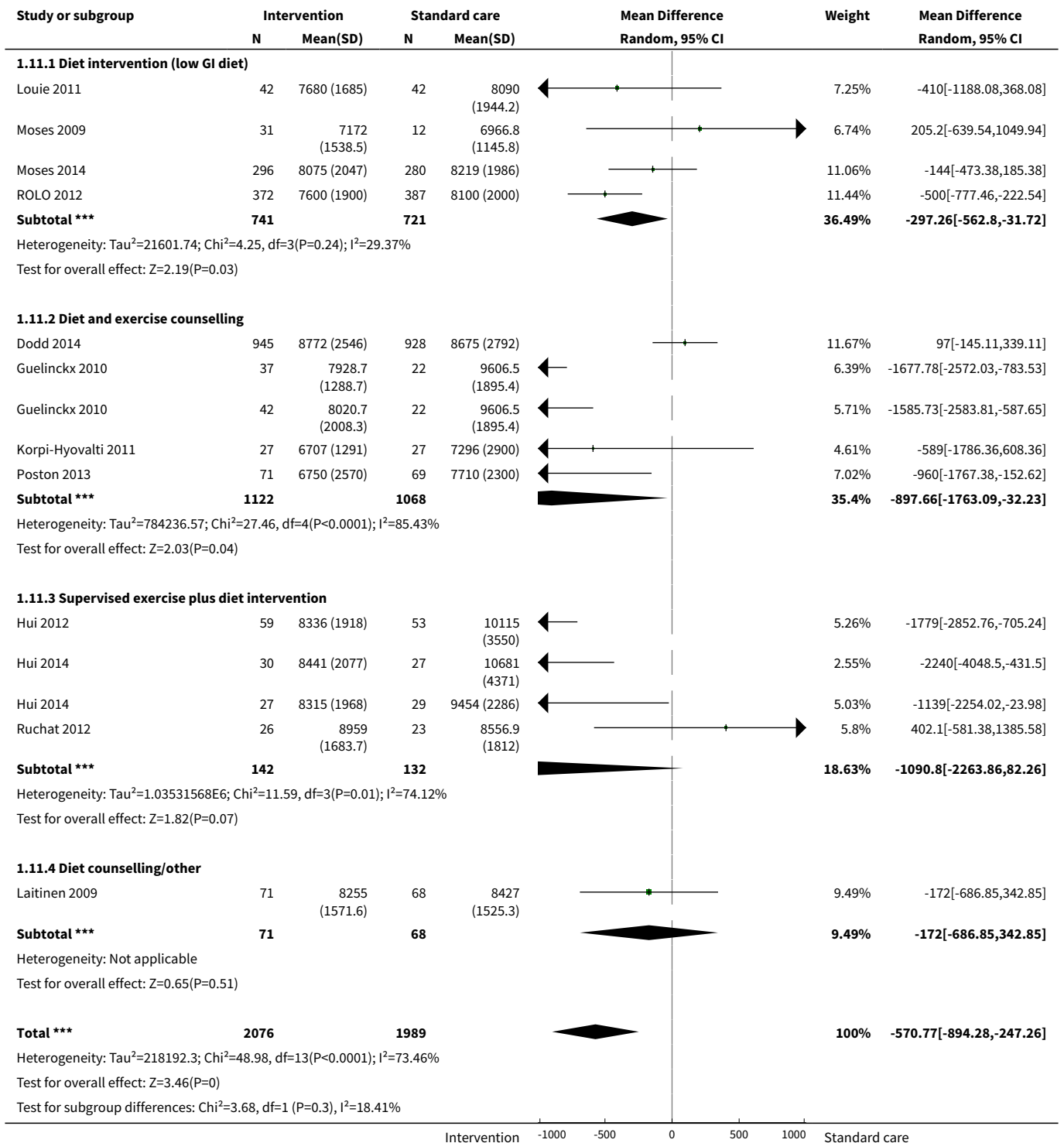




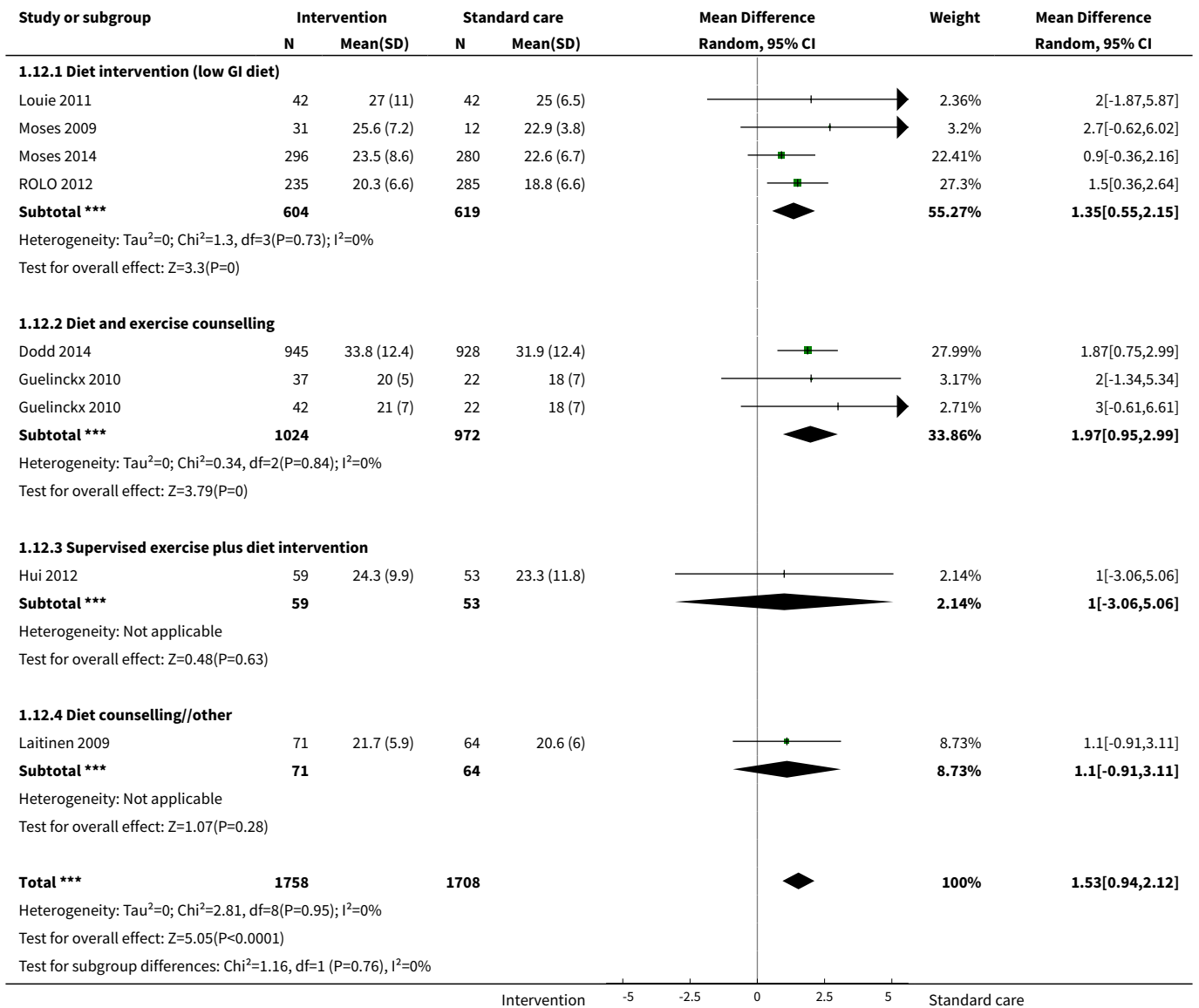
Analysis 1.10. Comparison 1 All diet and/or exercise interventions vs standard/other care, Outcome 10 Postpartum weight retention (n/N; investigator defined time frame).



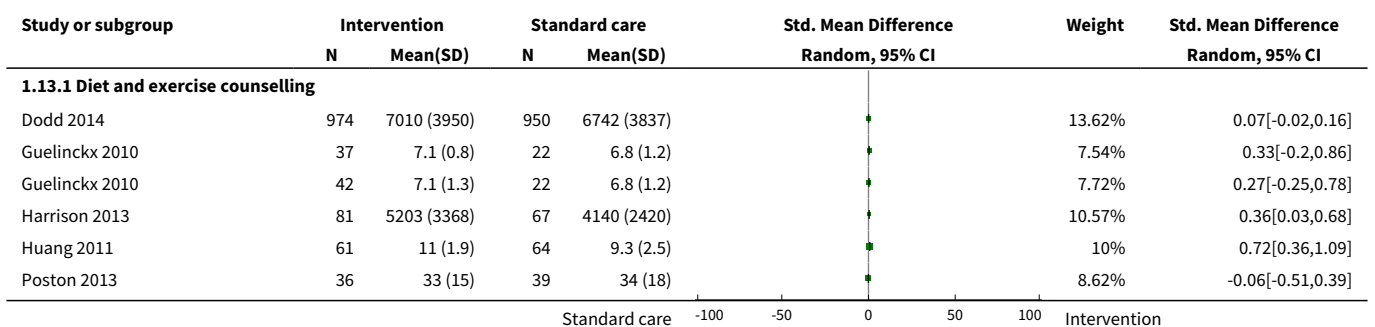
Analysis 1.11. Comparison 1 All diet and/or exercise interventions vs standard/other care, Outcome 11 Energy intake (kj).

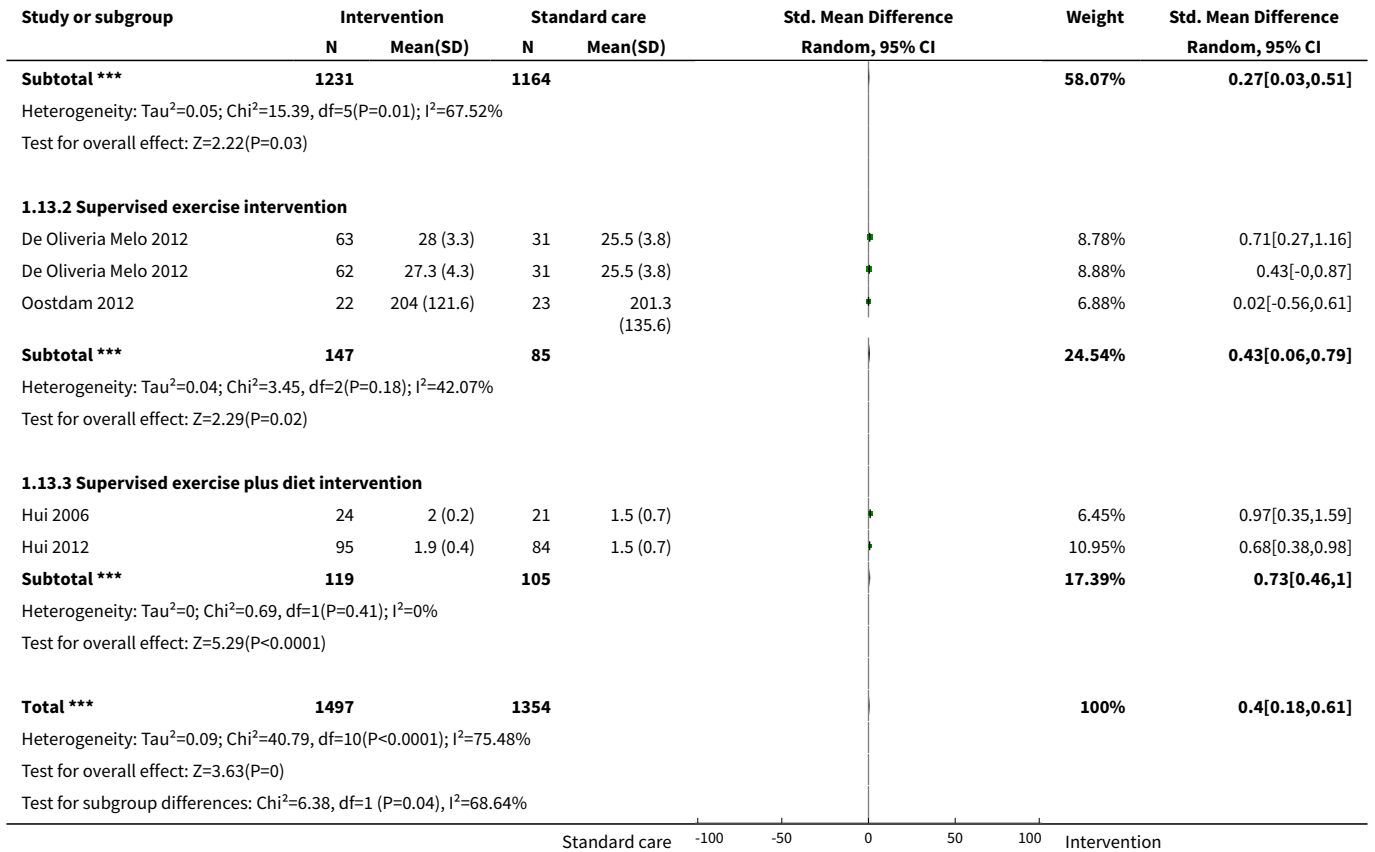


Analysis 1.12. Comparison 1 All diet and/or exercise interventions vs standard/other care, Outcome 12 Fibre intake (g).

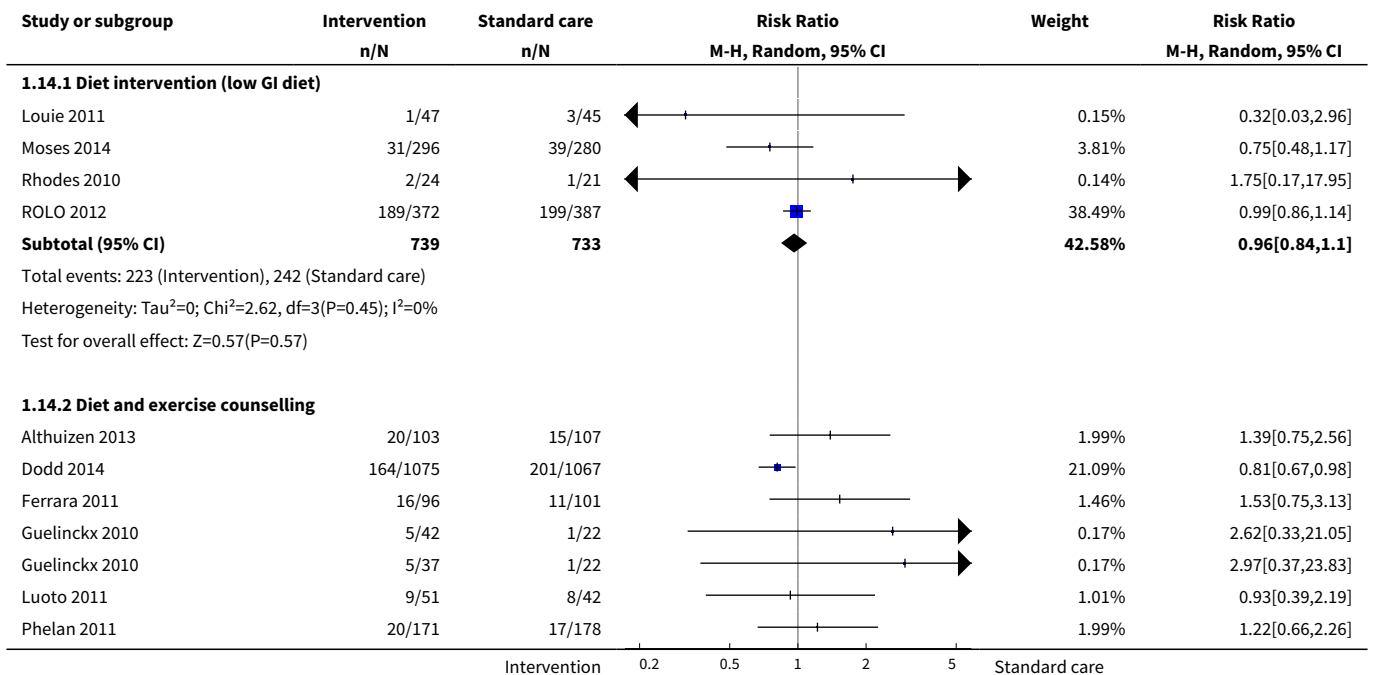


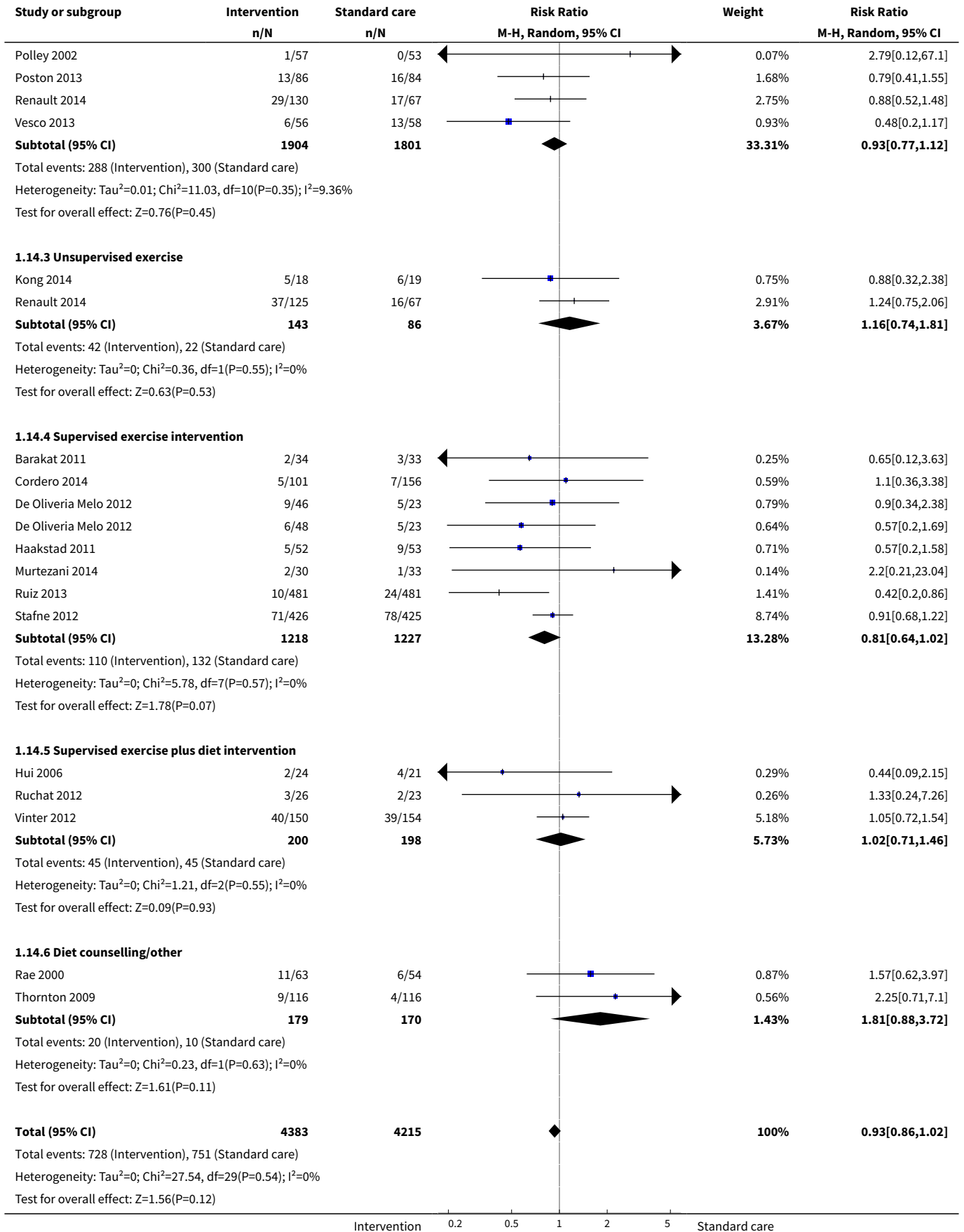
Analysis 1.13. Comparison 1 All diet and/or exercise interventions vs standard/other care, Outcome 13 Physical activity score (26-29 weeks).





Analysis 1.14. Comparison 1 All diet and/or exercise interventions vs standard/other care, Outcome 14 Macrosomia Infant birthweight > 4000 g.





Study or subgroup	Intervention n/N	Standard care n/N	Risk Ratio M-H, Random, 95% CI	Weight	Risk Ratio M-H, Random, 95% CI
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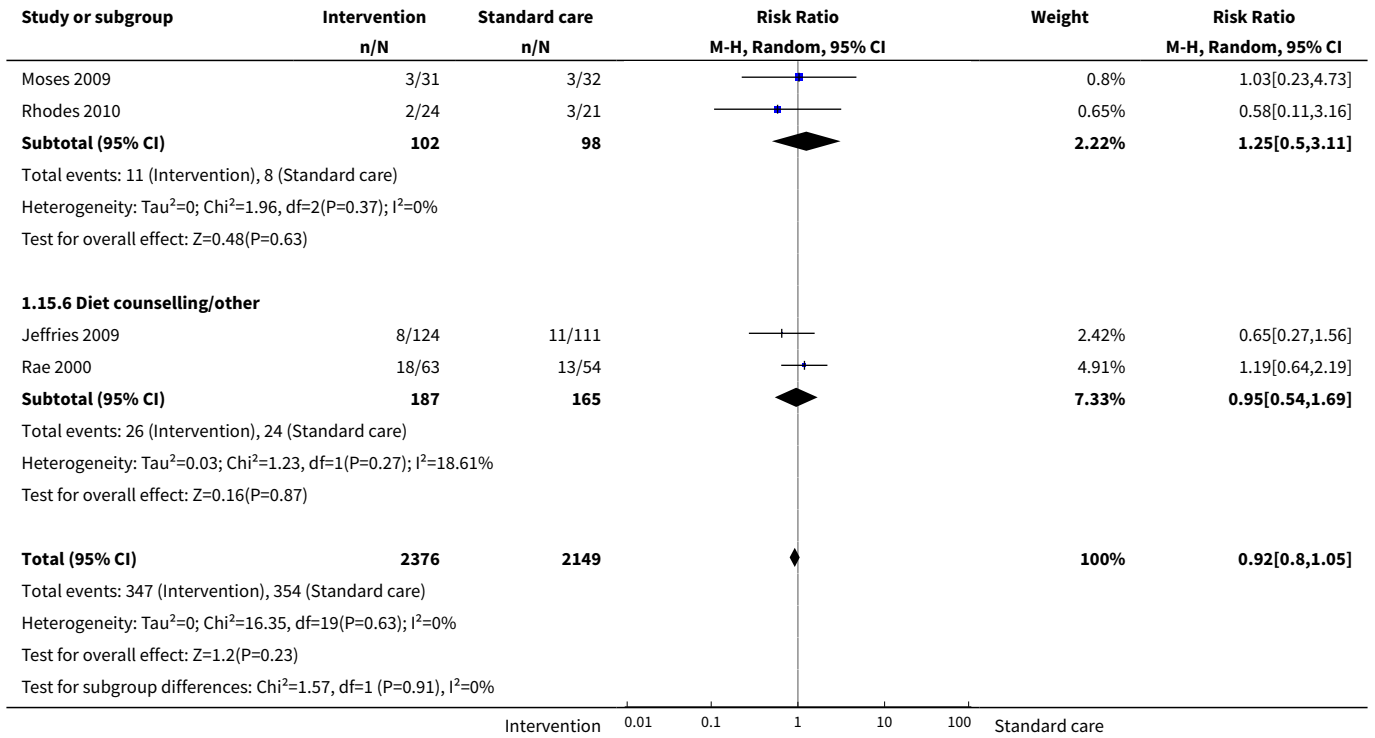
Test for subgroup differences: $\chi^2=5.87$, $df=1$ ($P=0.32$), $I^2=14.78\%$

Intervention 0.2 0.5 1 2 5 Standard care

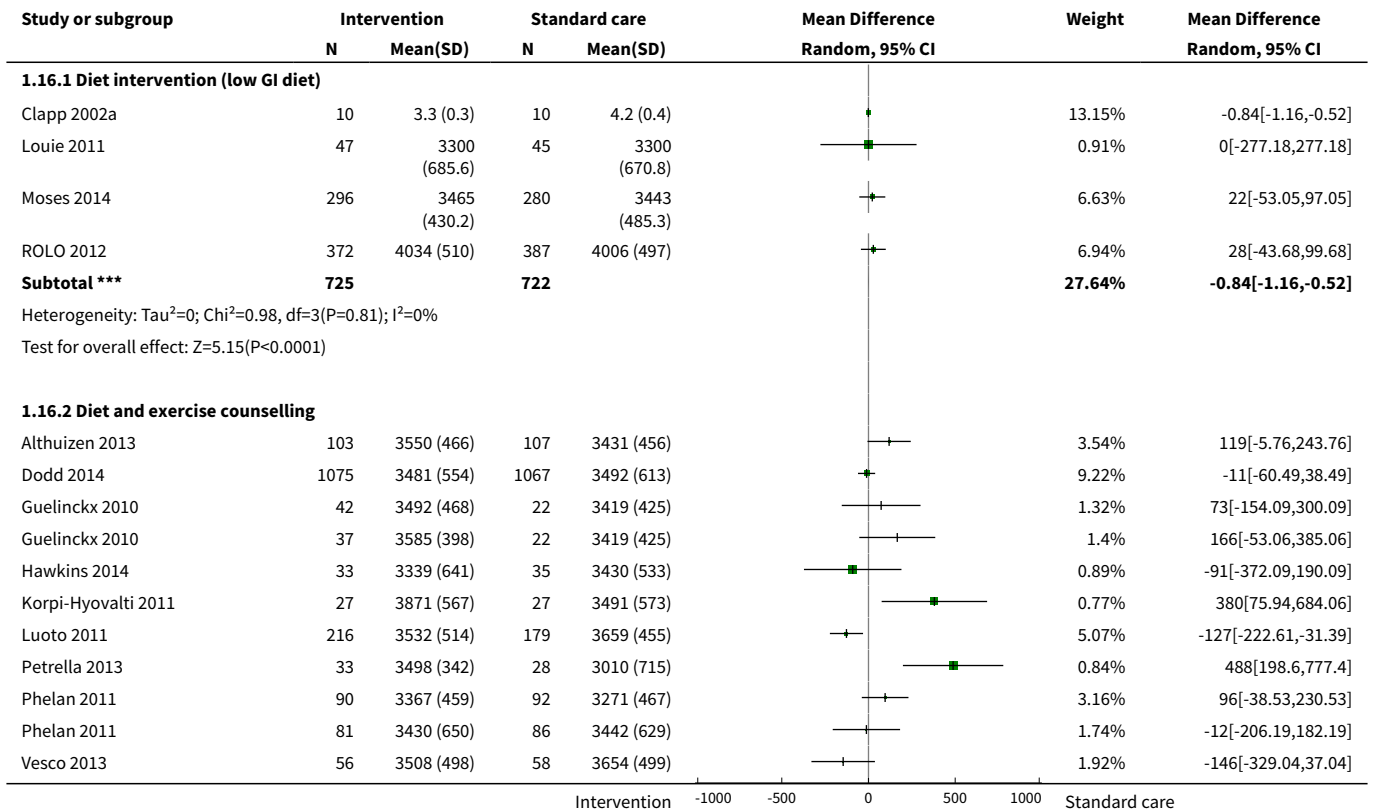
Analysis 1.15. Comparison 1 All diet and/or exercise interventions vs standard/other care, Outcome 15 Infant birthweight > 90th centile.

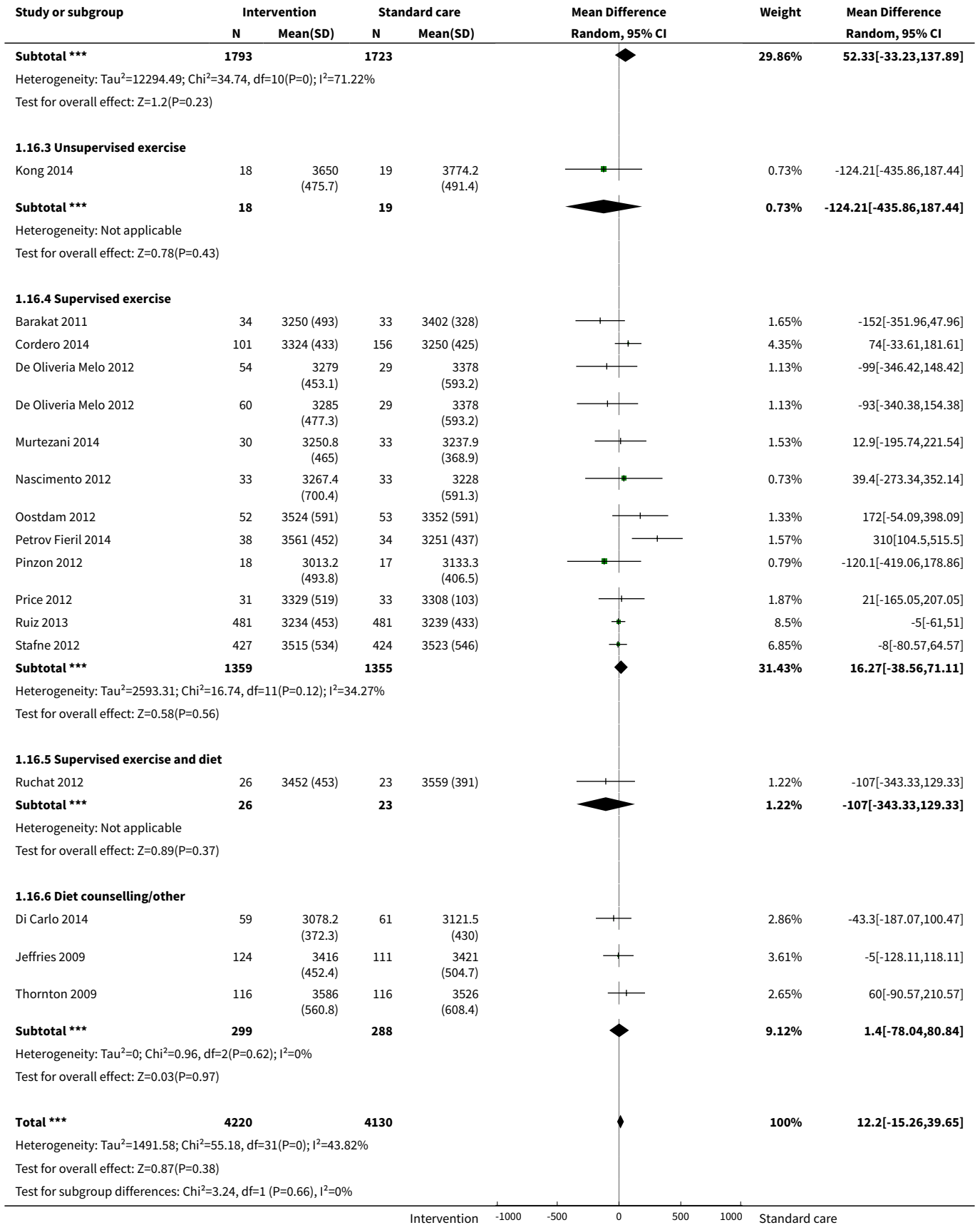
Study or subgroup	Intervention n/N	Standard care n/N	Risk Ratio M-H, Random, 95% CI	Weight	Risk Ratio M-H, Random, 95% CI
1.15.1 Diet and exercise counselling					
Dodd 2014	203/1075	224/1067		64%	0.9[0.76,1.07]
Luoto 2011	6/51	8/42		1.94%	0.62[0.23,1.64]
Polley 2002	4/30	3/31		0.93%	1.38[0.34,5.64]
Poston 2013	7/86	7/84		1.84%	0.98[0.36,2.66]
Renault 2014	9/130	5/67		1.67%	0.93[0.32,2.66]
Vesco 2013	5/56	15/58		2.08%	0.35[0.13,0.89]
Subtotal (95% CI)	1428	1349		72.45%	0.87[0.74,1.02]
Total events: 234 (Intervention), 262 (Standard care)					
Heterogeneity: $\tau^2=0$; $\chi^2=4.79$, $df=5$ ($P=0.44$); $I^2=0\%$					
Test for overall effect: $Z=1.66$ ($P=0.1$)					
1.15.2 Unsupervised exercise					
Renault 2014	8/125	4/67		1.37%	1.07[0.34,3.43]
Subtotal (95% CI)	125	67		1.37%	1.07[0.34,3.43]
Total events: 8 (Intervention), 4 (Standard care)					
Heterogeneity: Not applicable					
Test for overall effect: $Z=0.12$ ($P=0.91$)					
1.15.3 Supervised exercise intervention					
De Oliveria Melo 2012	3/54	3/29		0.78%	0.54[0.12,2.49]
De Oliveria Melo 2012	4/60	3/29		0.9%	0.64[0.15,2.69]
Nascimento 2012	8/33	8/33		2.54%	1[0.43,2.35]
Oostdam 2012	6/47	1/50		0.43%	6.38[0.8,51.05]
Price 2012	6/31	4/31		1.37%	1.5[0.47,4.8]
Subtotal (95% CI)	225	172		6.03%	1.09[0.59,2]
Total events: 27 (Intervention), 19 (Standard care)					
Heterogeneity: $\tau^2=0.06$; $\chi^2=4.56$, $df=4$ ($P=0.34$); $I^2=12.22\%$					
Test for overall effect: $Z=0.27$ ($P=0.78$)					
1.15.4 Supervised exercise plus diet intervention					
Hui 2012	12/102	15/88		3.74%	0.69[0.34,1.39]
Hui 2014	6/57	4/56		1.26%	1.47[0.44,4.94]
Vinter 2012	23/150	18/154		5.61%	1.31[0.74,2.33]
Subtotal (95% CI)	309	298		10.61%	1.06[0.67,1.66]
Total events: 41 (Intervention), 37 (Standard care)					
Heterogeneity: $\tau^2=0.02$; $\chi^2=2.24$, $df=2$ ($P=0.33$); $I^2=10.84\%$					
Test for overall effect: $Z=0.24$ ($P=0.81$)					
1.15.5 Diet intervention (low GI diet)					
Louie 2011	6/47	2/45		0.77%	2.87[0.61,13.5]

Intervention 0.01 0.1 1 10 100 Standard care

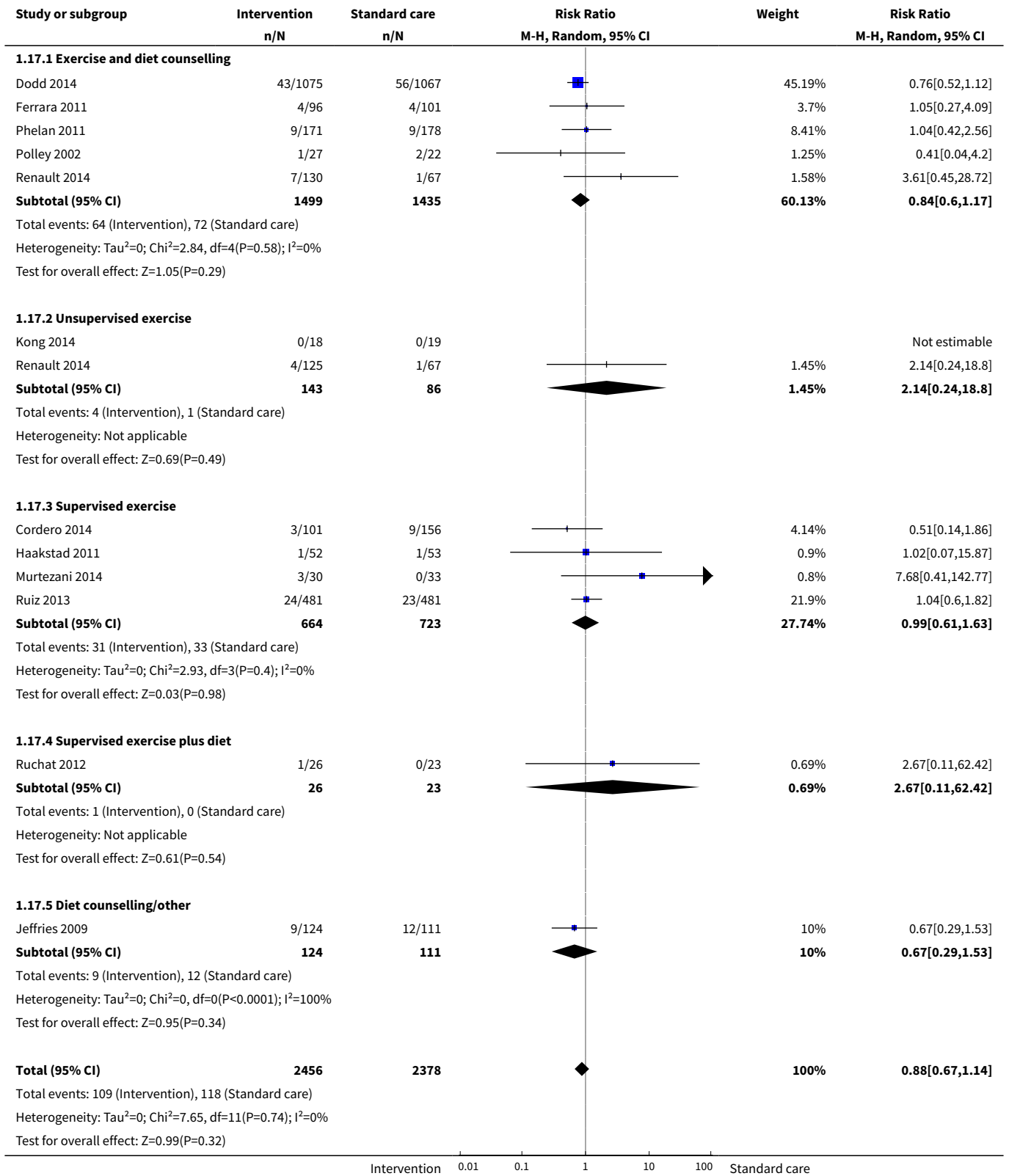


Analysis 1.16. Comparison 1 All diet and/or exercise interventions vs standard/other care, Outcome 16 Birthweight (g) (not prespecified).





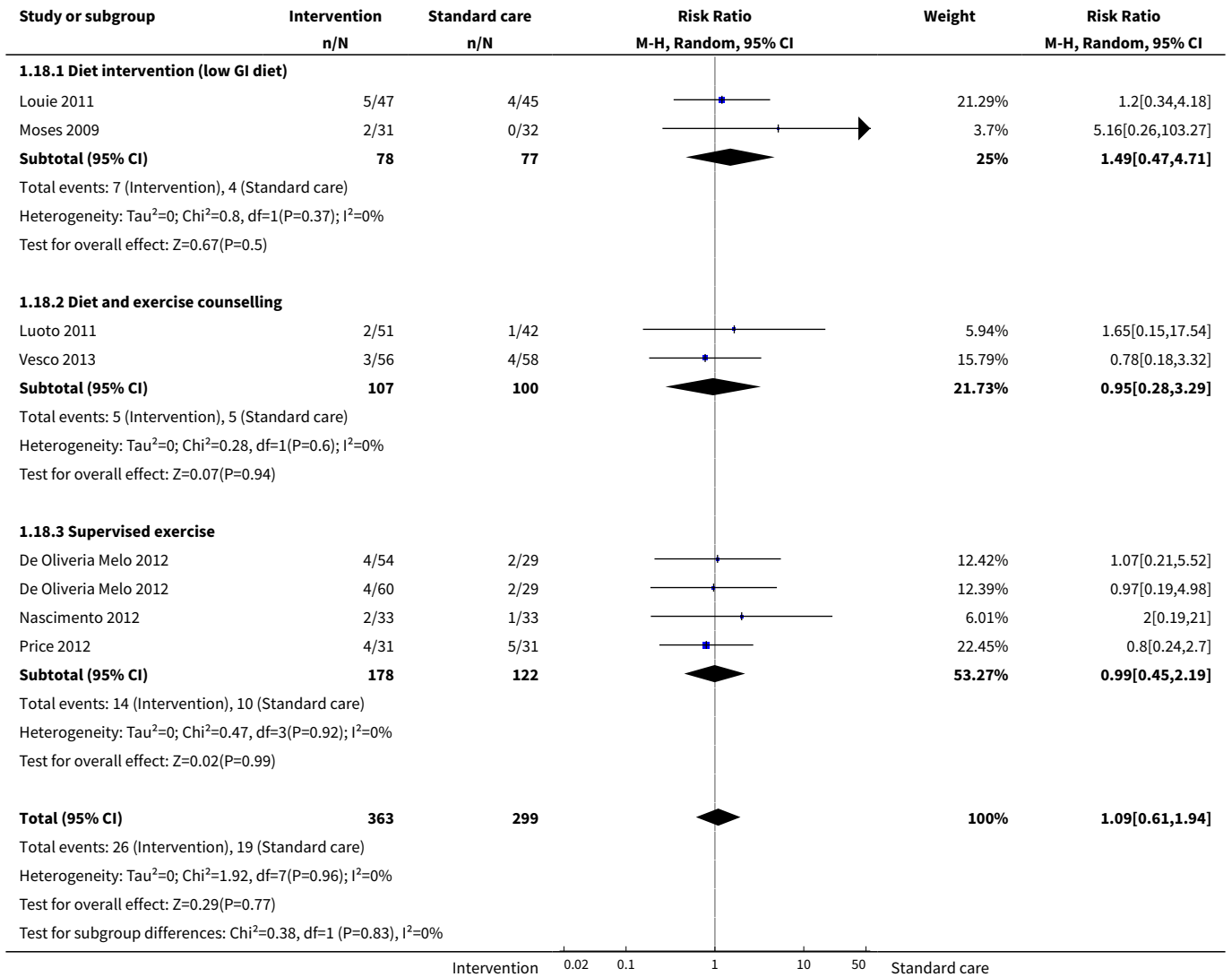
Analysis 1.17. Comparison 1 All diet and/or exercise interventions vs standard/other care, Outcome 17 Infant birthweight < 2500 g.



Study or subgroup	Intervention n/N	Standard care n/N	Risk Ratio M-H, Random, 95% CI	Weight	Risk Ratio M-H, Random, 95% CI
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Test for subgroup differences: $\text{Chi}^2=1.86, \text{df}=1 (P=0.76), I^2=0\%$

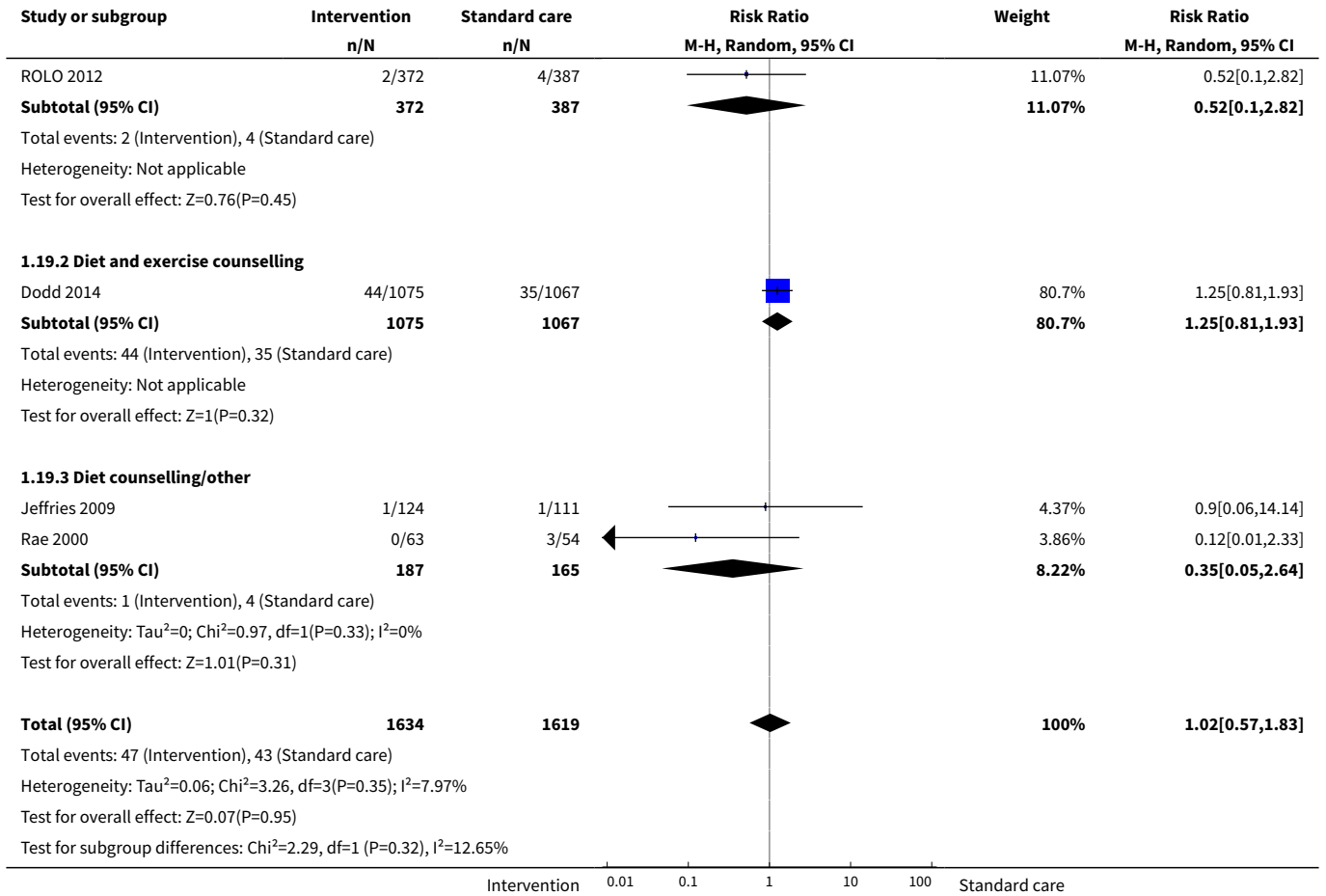
Analysis 1.18. Comparison 1 All diet and/or exercise interventions vs standard/other care, Outcome 18 Infant birthweight < 10th centile.



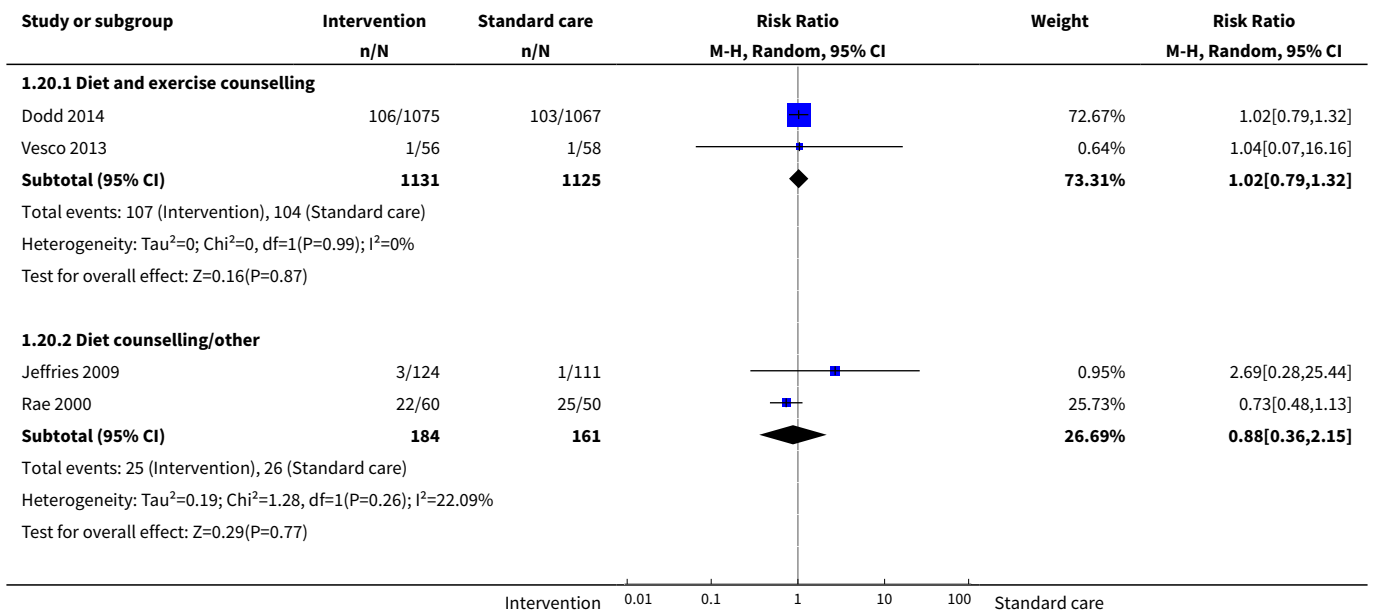
Analysis 1.19. Comparison 1 All diet and/or exercise interventions vs standard/other care, Outcome 19 Shoulder dystocia.

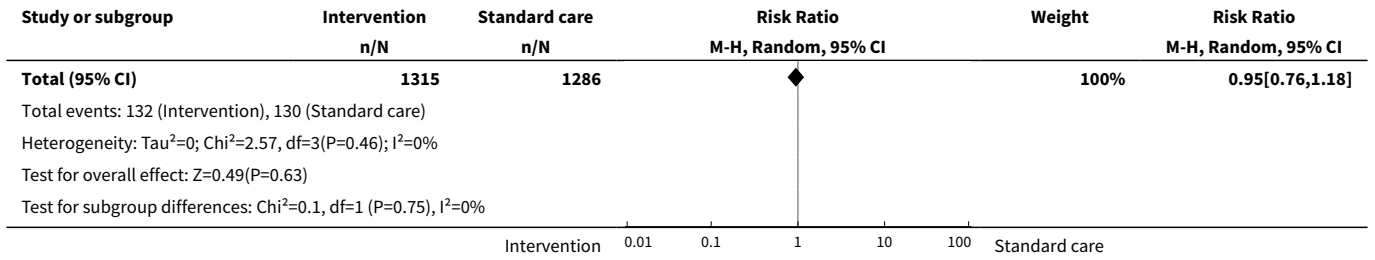
Study or subgroup	Intervention n/N	Standard care n/N	Risk Ratio M-H, Random, 95% CI	Weight	Risk Ratio M-H, Random, 95% CI
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1.19.1 Diet intervention (low GI diet)

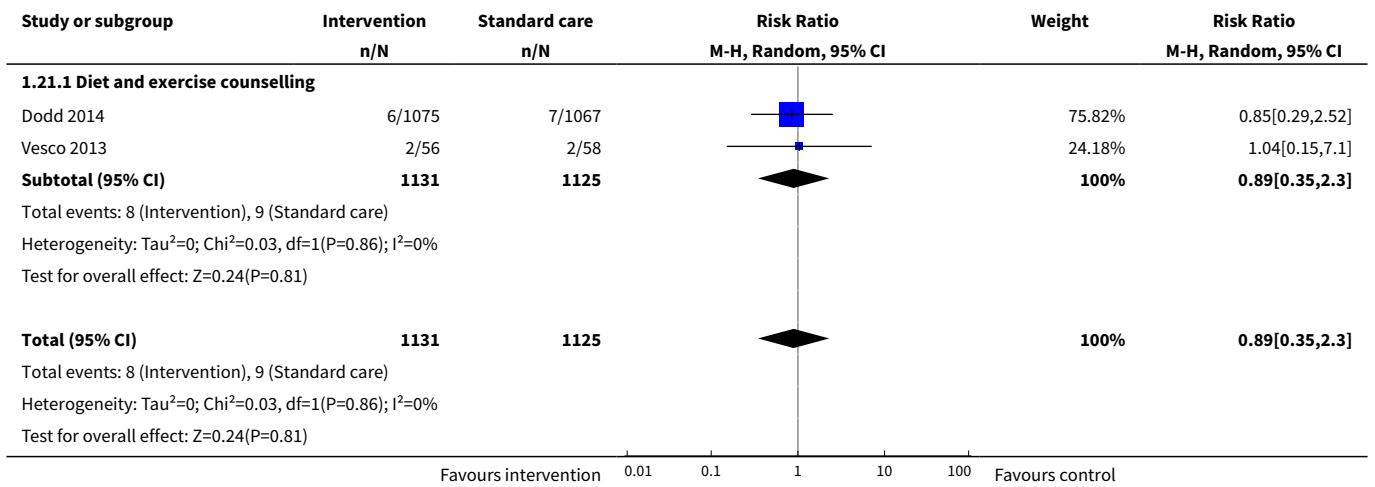


Analysis 1.20. Comparison 1 All diet and/or exercise interventions vs standard/other care, Outcome 20 Neonatal hypoglycaemia.

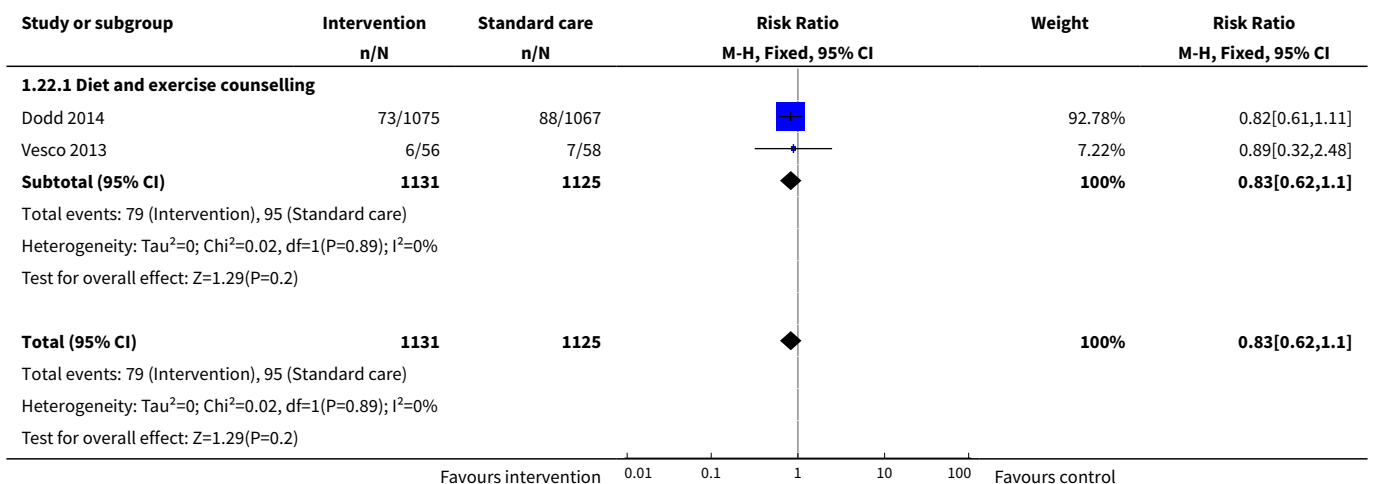




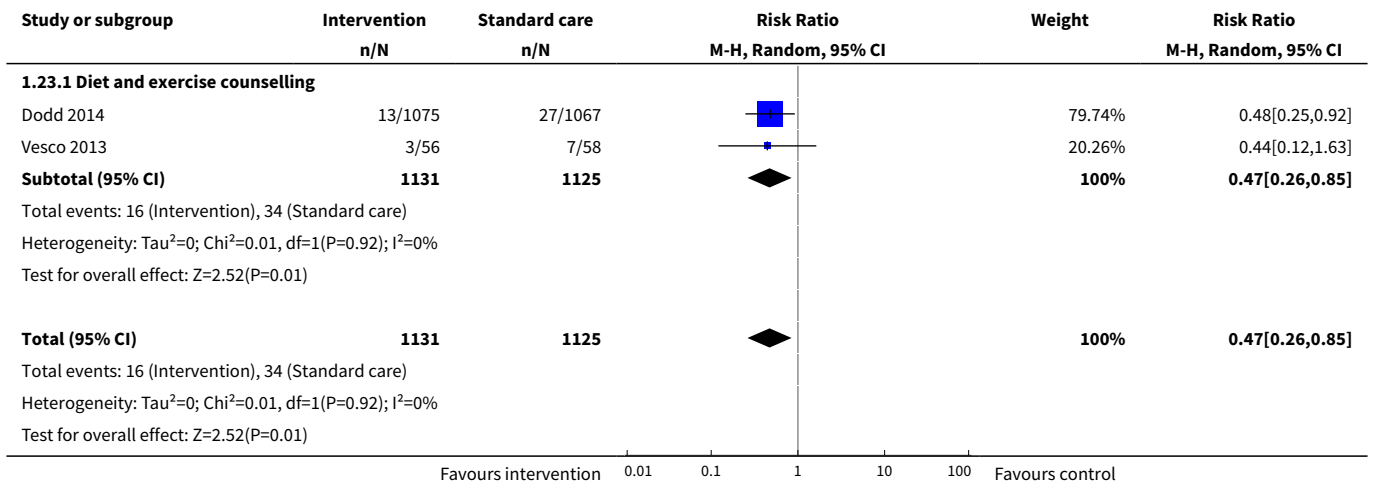
Analysis 1.21. Comparison 1 All diet and/or exercise interventions vs standard/other care, Outcome 21 Birth trauma.



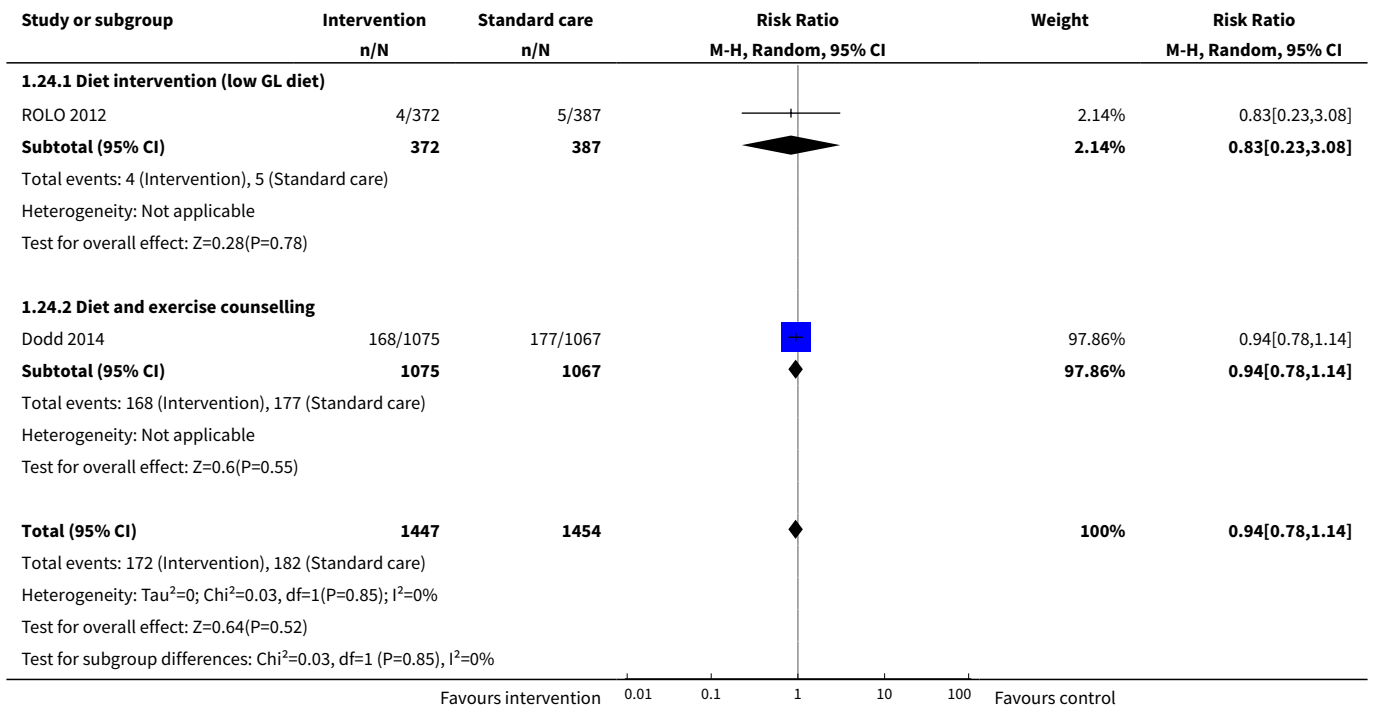
Analysis 1.22. Comparison 1 All diet and/or exercise interventions vs standard/other care, Outcome 22 Neonatal hyperbilirubinaemia.



Analysis 1.23. Comparison 1 All diet and/or exercise interventions vs standard/other care, Outcome 23 Neonatal respiratory distress syndrome.



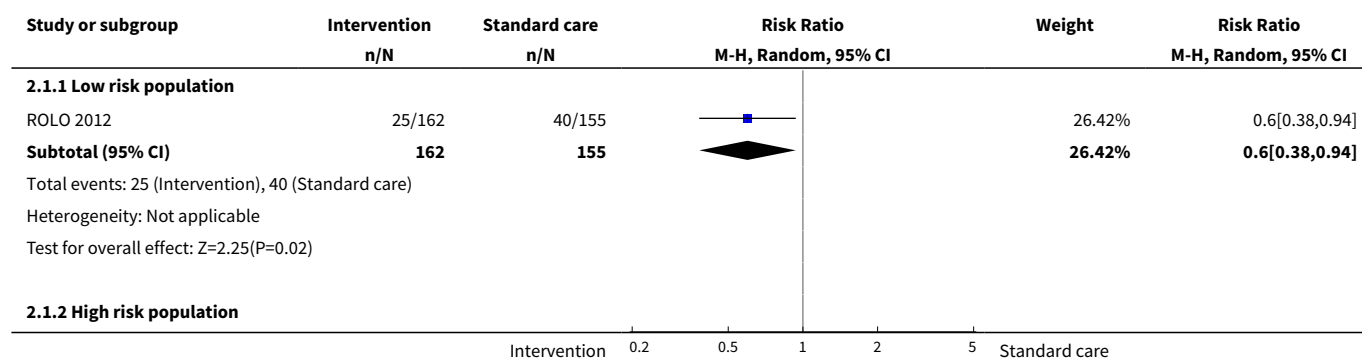
Analysis 1.24. Comparison 1 All diet and/or exercise interventions vs standard/other care, Outcome 24 Postpartum hemorrhage.

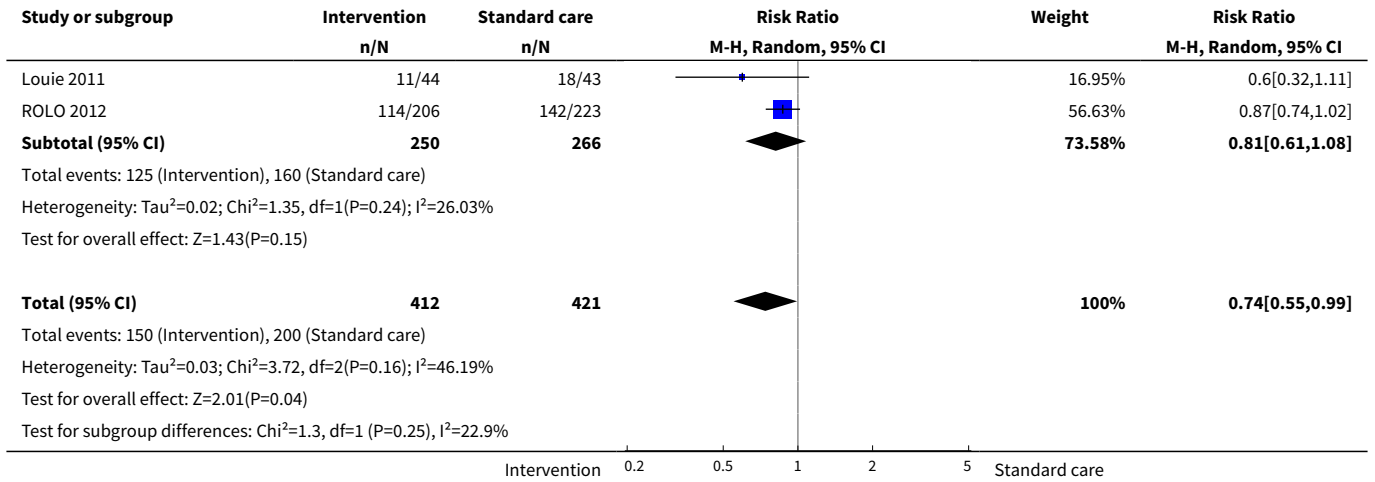


Comparison 2. Diet intervention (low GI diet) vs standard/other care

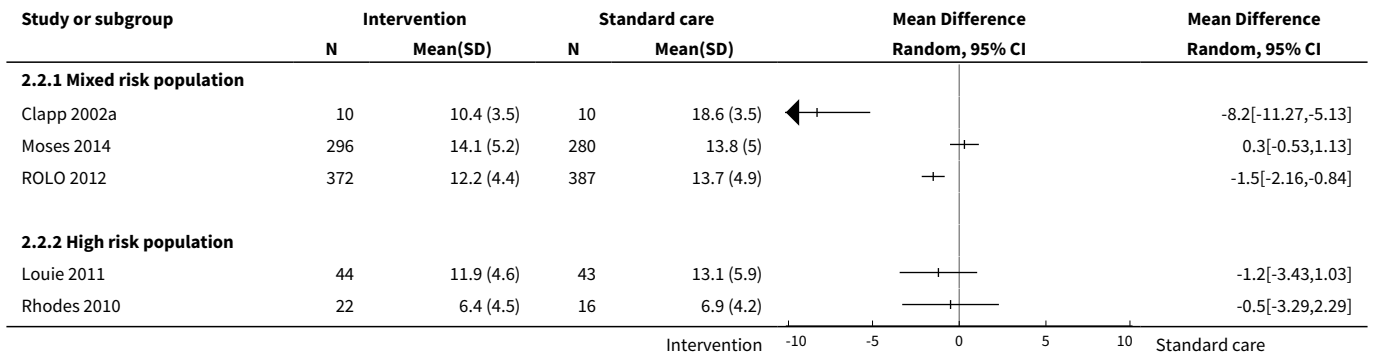
Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
1 Excessive weight gain	2	833	Risk Ratio (M-H, Random, 95% CI)	0.74 [0.55, 0.99]
1.1 Low risk population	1	317	Risk Ratio (M-H, Random, 95% CI)	0.60 [0.38, 0.94]
1.2 High risk population	2	516	Risk Ratio (M-H, Random, 95% CI)	0.81 [0.61, 1.08]
2 Weight gain (kg)	5		Mean Difference (IV, Random, 95% CI)	Totals not selected
2.1 Mixed risk population	3		Mean Difference (IV, Random, 95% CI)	0.0 [0.0, 0.0]
2.2 High risk population	2		Mean Difference (IV, Random, 95% CI)	0.0 [0.0, 0.0]
3 Low weight gain	1		Risk Ratio (M-H, Random, 95% CI)	Totals not selected
3.1 High risk population	1		Risk Ratio (M-H, Random, 95% CI)	0.0 [0.0, 0.0]
4 Preterm birth	2	804	Risk Ratio (M-H, Random, 95% CI)	0.33 [0.11, 1.02]
4.1 Mixed risk population	1	759	Risk Ratio (M-H, Random, 95% CI)	0.39 [0.10, 1.46]
4.2 High risk population	1	45	Risk Ratio (M-H, Random, 95% CI)	0.22 [0.03, 1.81]
5 Caesarean delivery	2	133	Risk Ratio (M-H, Random, 95% CI)	0.99 [0.33, 3.01]
5.1 High risk population	2	133	Risk Ratio (M-H, Random, 95% CI)	0.99 [0.33, 3.01]
6 Macrosomia (Infant birth-weight > 4000 g)	4	1472	Risk Ratio (M-H, Random, 95% CI)	0.96 [0.77, 1.20]
6.1 Mixed risk population	2	1335	Risk Ratio (M-H, Random, 95% CI)	0.93 [0.75, 1.17]
6.2 High risk population	2	137	Risk Ratio (M-H, Random, 95% CI)	2.47 [0.68, 8.95]

Analysis 2.1. Comparison 2 Diet intervention (low GI diet) vs standard/other care, Outcome 1 Excessive weight gain.

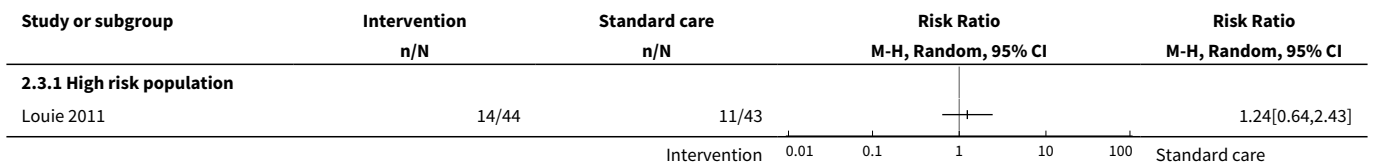




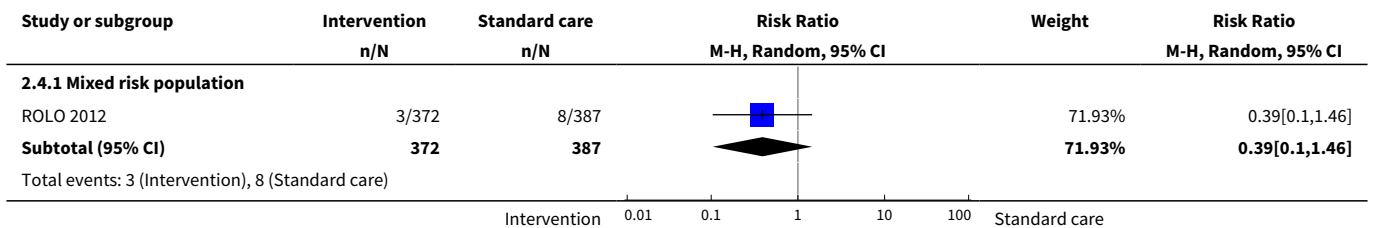
Analysis 2.2. Comparison 2 Diet intervention (low GI diet) vs standard/other care, Outcome 2 Weight gain (kg).

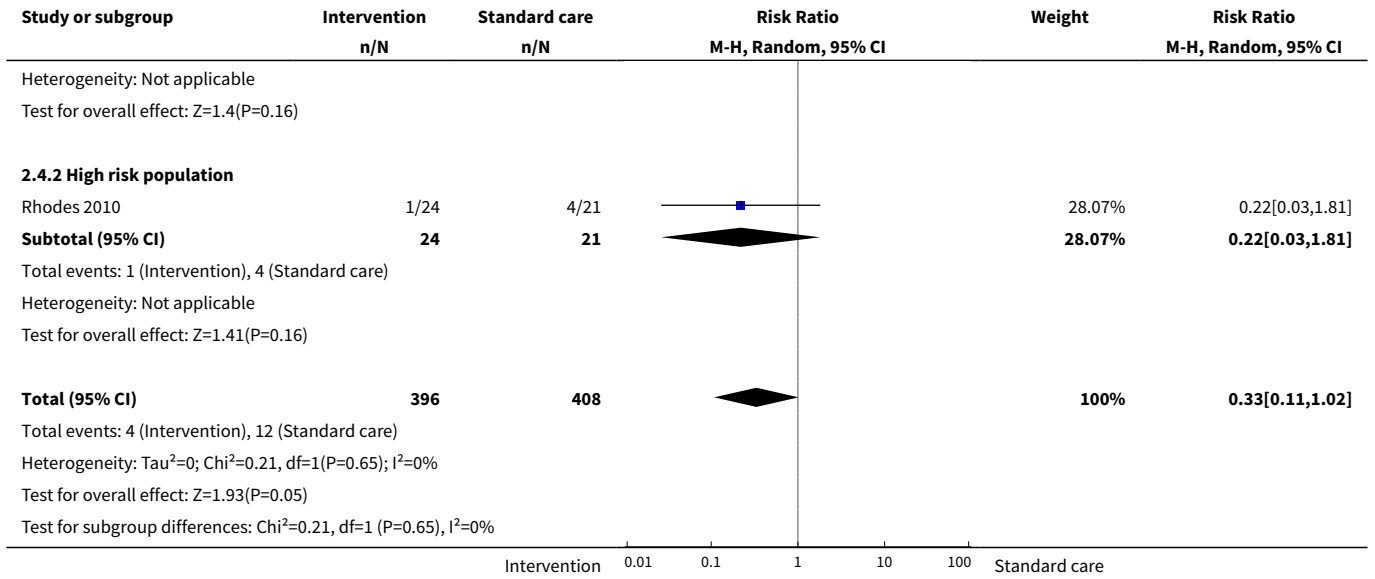


Analysis 2.3. Comparison 2 Diet intervention (low GI diet) vs standard/other care, Outcome 3 Low weight gain.

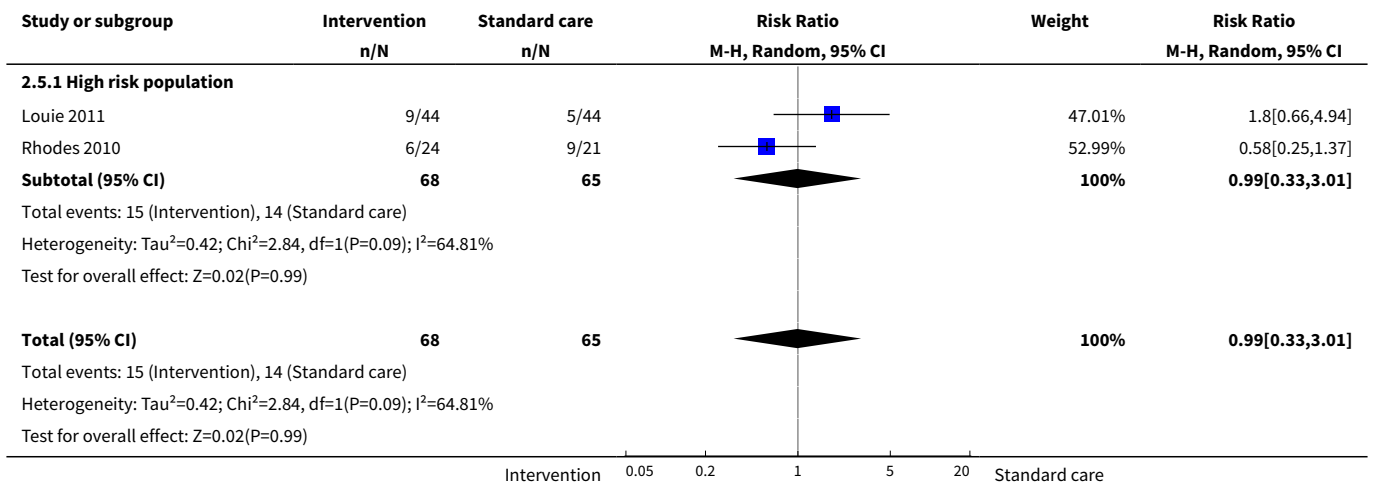


Analysis 2.4. Comparison 2 Diet intervention (low GI diet) vs standard/other care, Outcome 4 Preterm birth.

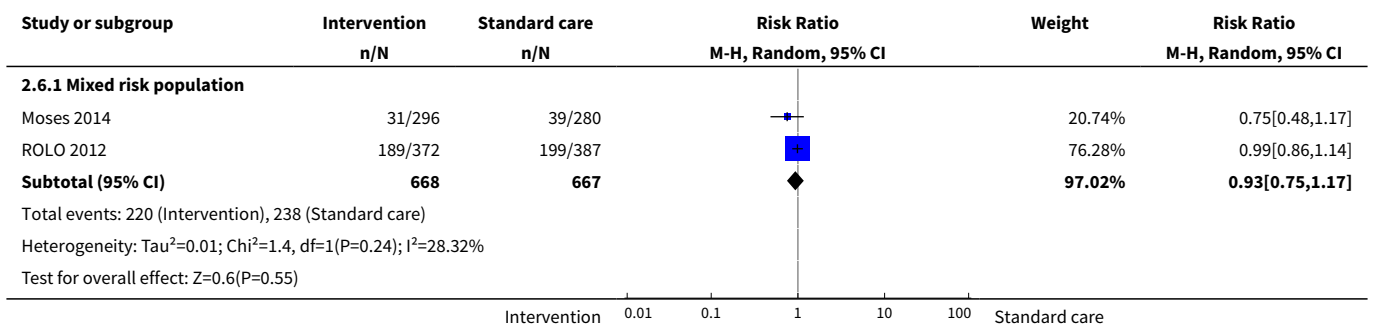


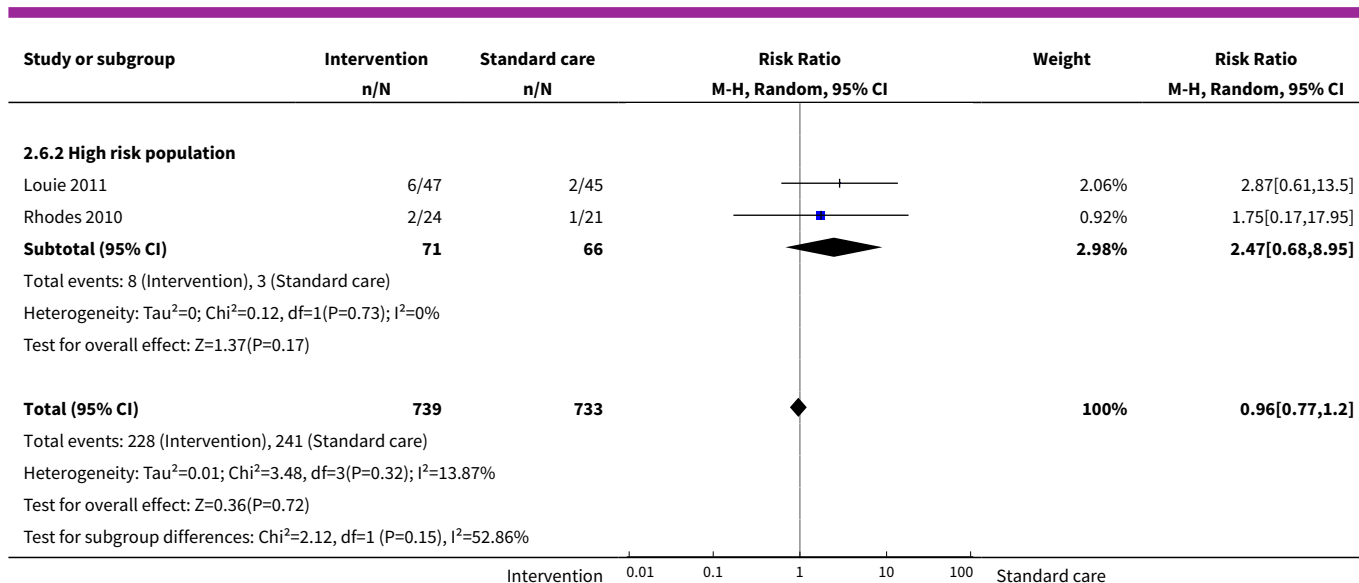


Analysis 2.5. Comparison 2 Diet intervention (low GI diet) vs standard/other care, Outcome 5 Caesarean delivery.



Analysis 2.6. Comparison 2 Diet intervention (low GI diet) vs standard/other care, Outcome 6 Macrosomia (Infant birthweight > 4000 g).



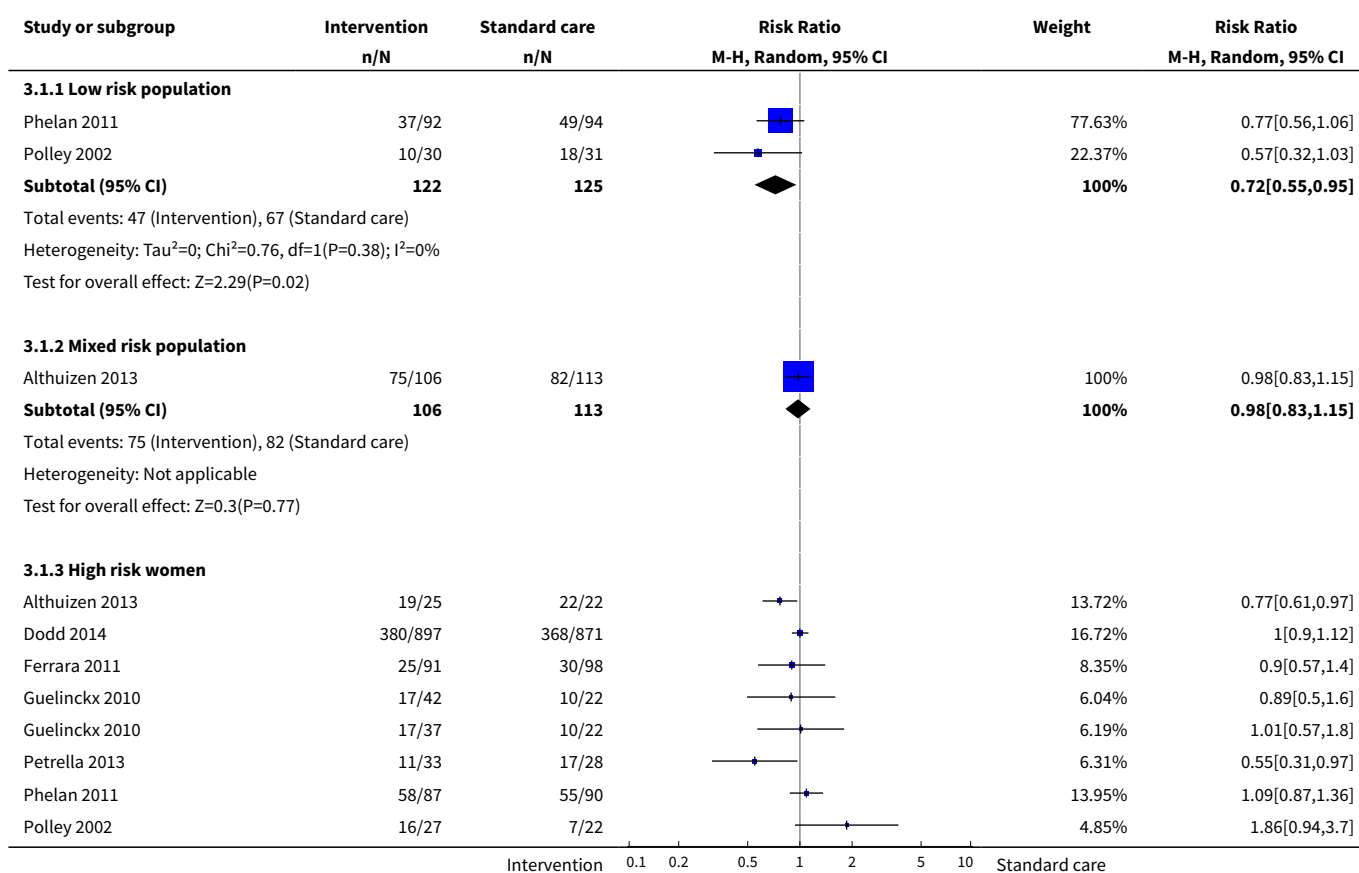


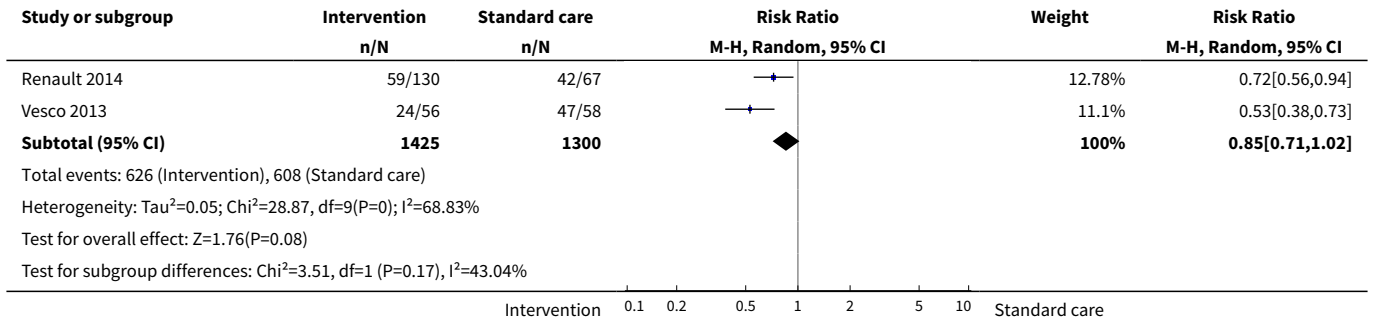
Comparison 3. Diet and exercise counselling vs standard/other care

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
1 Excessive weight gain	9		Risk Ratio (M-H, Random, 95% CI)	Subtotals only
1.1 Low risk population	2	247	Risk Ratio (M-H, Random, 95% CI)	0.72 [0.55, 0.95]
1.2 Mixed risk population	1	219	Risk Ratio (M-H, Random, 95% CI)	0.98 [0.83, 1.15]
1.3 High risk women	9	2725	Risk Ratio (M-H, Random, 95% CI)	0.85 [0.71, 1.02]
2 Weight gain (kg)	13		Mean Difference (IV, Random, 95% CI)	Subtotals only
2.1 Low risk population	2	241	Mean Difference (IV, Random, 95% CI)	-0.92 [-2.12, 0.29]
2.2 Mixed risk population	3	444	Mean Difference (IV, Random, 95% CI)	-1.80 [-3.36, -0.24]
2.3 High risk women	11	2741	Mean Difference (IV, Random, 95% CI)	-0.71 [-1.34, -0.08]
3 Low weight gain	5	2552	Risk Ratio (M-H, Random, 95% CI)	1.23 [0.89, 1.72]
3.1 Low risk population	2	247	Risk Ratio (M-H, Random, 95% CI)	1.34 [0.74, 2.39]
3.2 High risk women	5	2305	Risk Ratio (M-H, Random, 95% CI)	1.21 [0.79, 1.85]
4 Preterm birth	7	3170	Risk Ratio (M-H, Random, 95% CI)	0.94 [0.57, 1.55]
4.1 Low risk population	2	243	Risk Ratio (M-H, Random, 95% CI)	0.98 [0.19, 5.09]
4.2 Mixed risk population	1	197	Risk Ratio (M-H, Random, 95% CI)	1.63 [0.84, 3.18]
4.3 High risk population	6	2730	Risk Ratio (M-H, Random, 95% CI)	0.83 [0.43, 1.60]
5 Pre-eclampsia	7	3139	Risk Ratio (M-H, Random, 95% CI)	1.00 [0.75, 1.34]

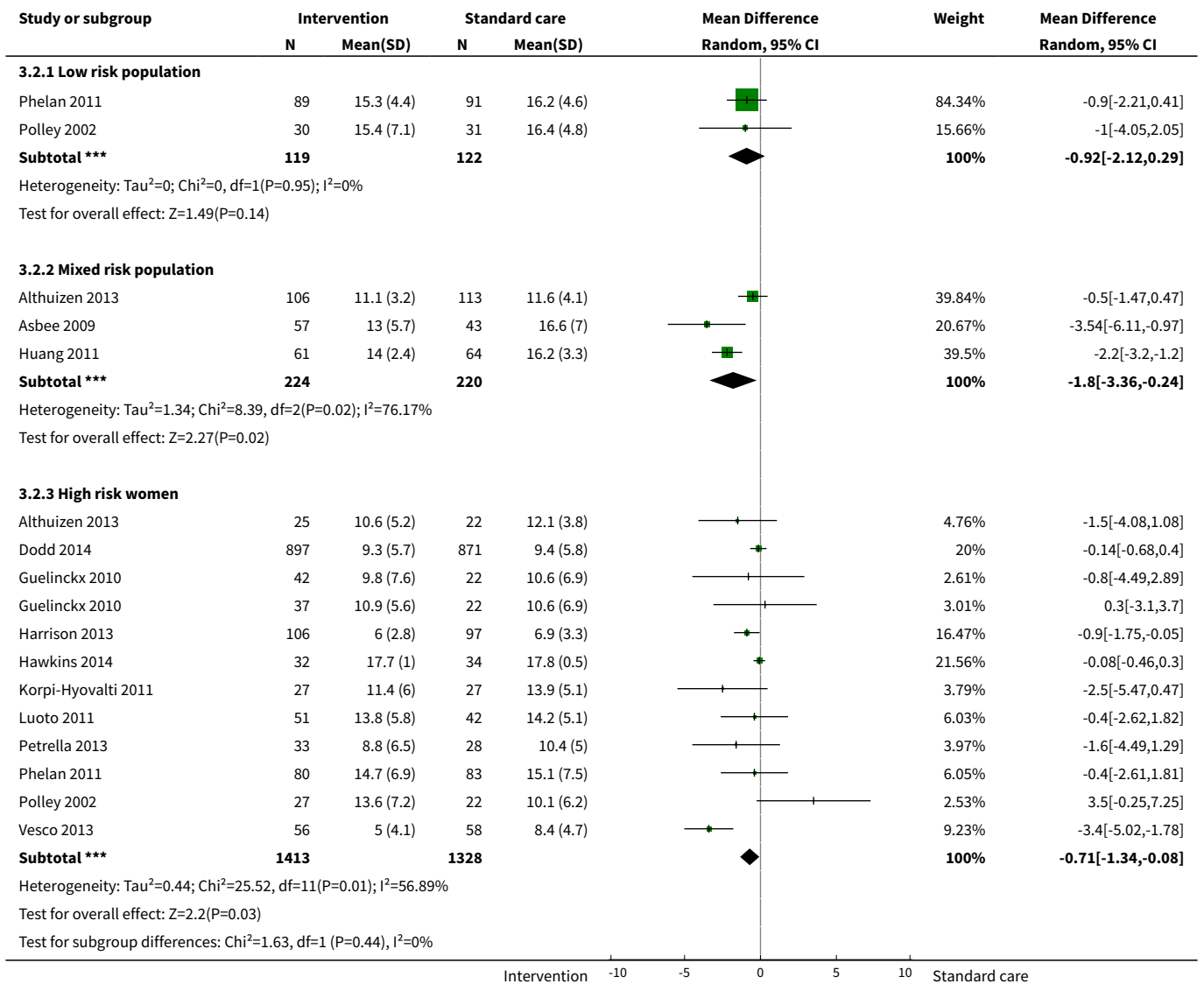
Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
5.1 Low risk population	2	243	Risk Ratio (M-H, Random, 95% CI)	0.34 [0.10, 1.22]
5.2 High risk women	7	2896	Risk Ratio (M-H, Random, 95% CI)	1.06 [0.79, 1.43]
6 Caesarean delivery	9	3406	Risk Ratio (M-H, Random, 95% CI)	0.89 [0.80, 1.00]
6.1 Low risk population	2	243	Risk Ratio (M-H, Random, 95% CI)	0.93 [0.59, 1.48]
6.2 Mixed risk population	2	310	Risk Ratio (M-H, Random, 95% CI)	0.66 [0.41, 1.05]
6.3 High risk women	7	2853	Risk Ratio (M-H, Random, 95% CI)	0.89 [0.76, 1.04]
7 Macrosomia (Infant birthweight > 4000 g)	10	3705	Risk Ratio (M-H, Random, 95% CI)	0.92 [0.77, 1.11]
7.1 Low risk population	2	243	Risk Ratio (M-H, Random, 95% CI)	2.18 [0.63, 7.58]
7.2 Mixed risk population	1	210	Risk Ratio (M-H, Random, 95% CI)	1.39 [0.75, 2.56]
7.3 High risk women	9	3252	Risk Ratio (M-H, Random, 95% CI)	0.85 [0.73, 1.00]

Analysis 3.1. Comparison 3 Diet and exercise counselling vs standard/other care, Outcome 1 Excessive weight gain.

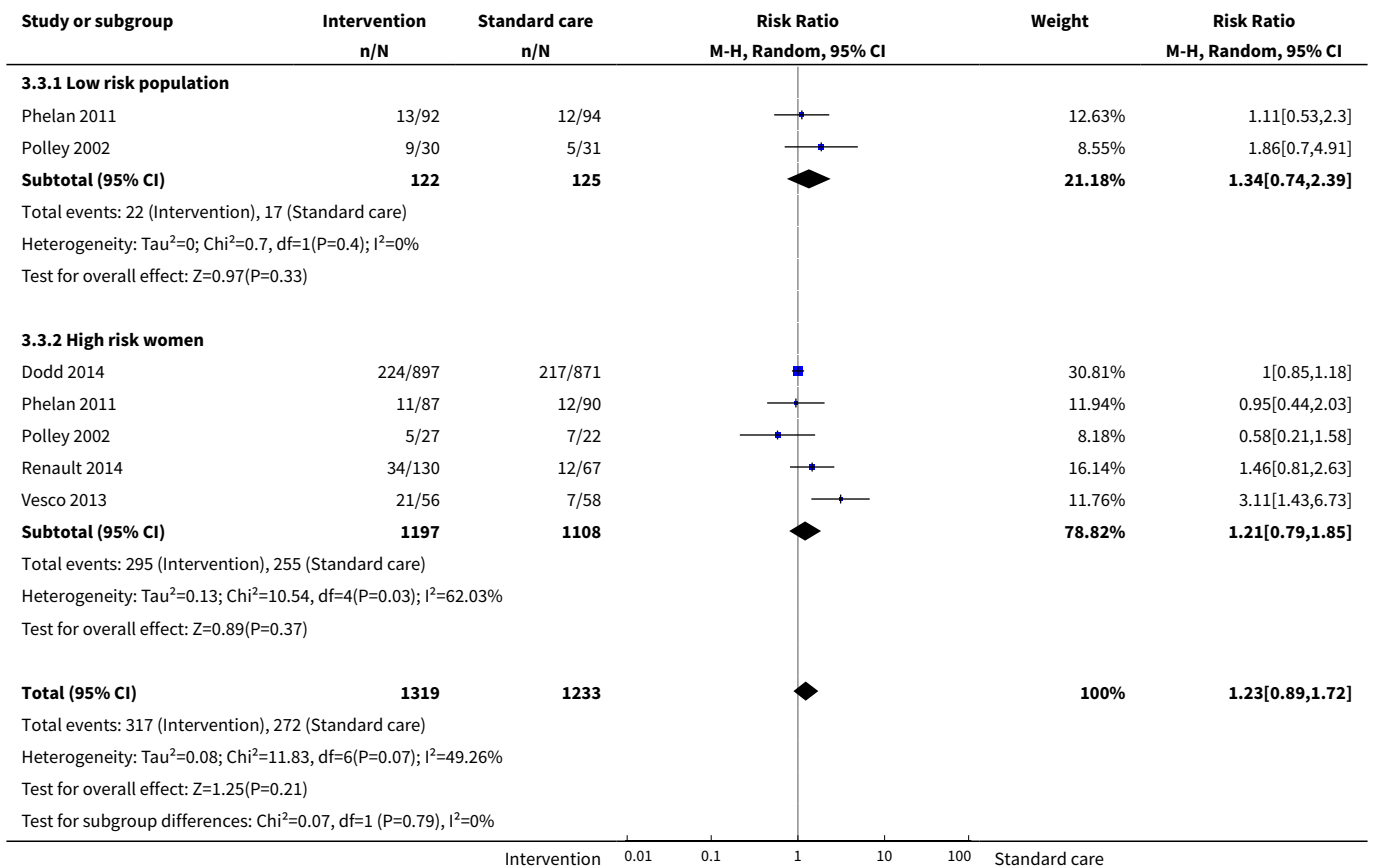




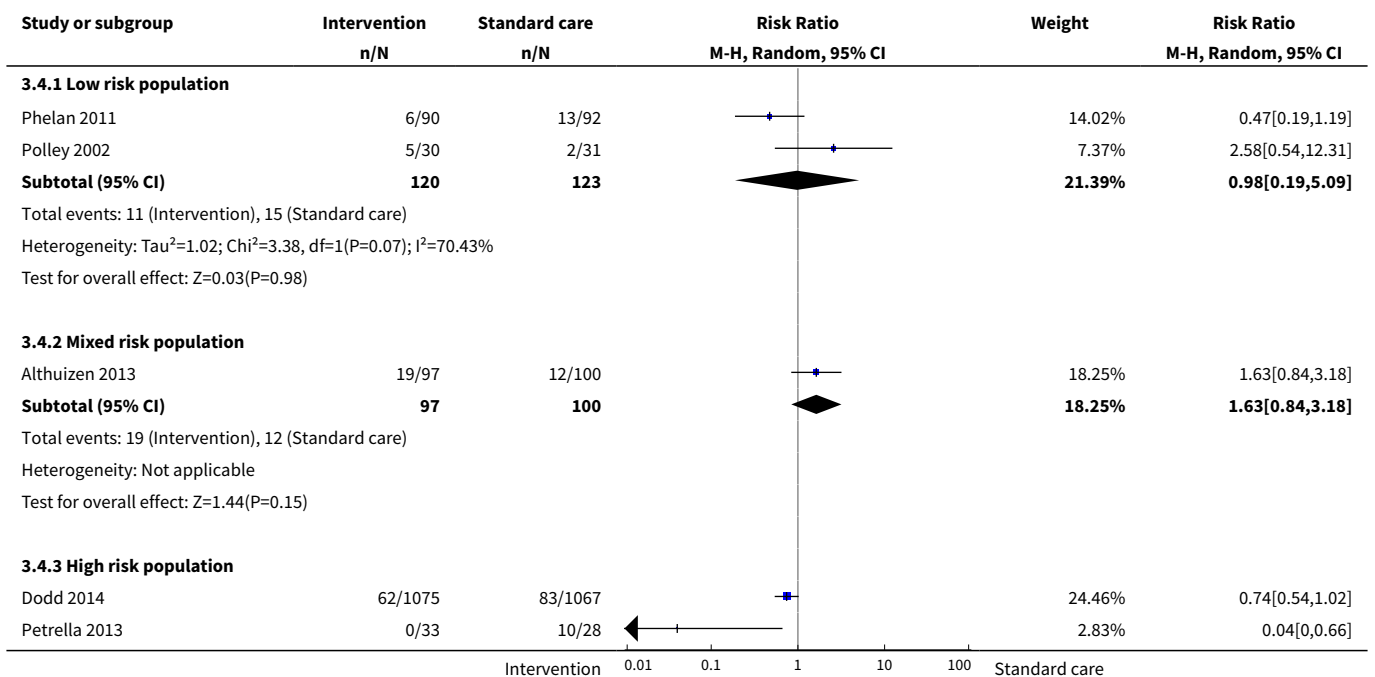
Analysis 3.2. Comparison 3 Diet and exercise counselling vs standard/other care, Outcome 2 Weight gain (kg).

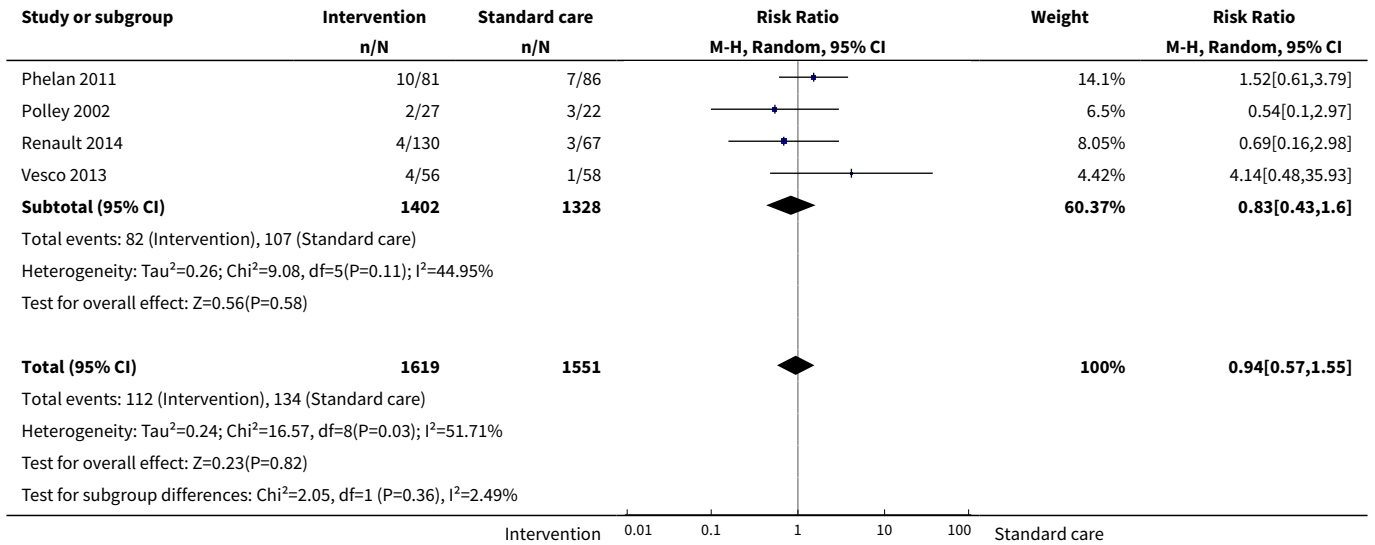


Analysis 3.3. Comparison 3 Diet and exercise counselling vs standard/other care, Outcome 3 Low weight gain.

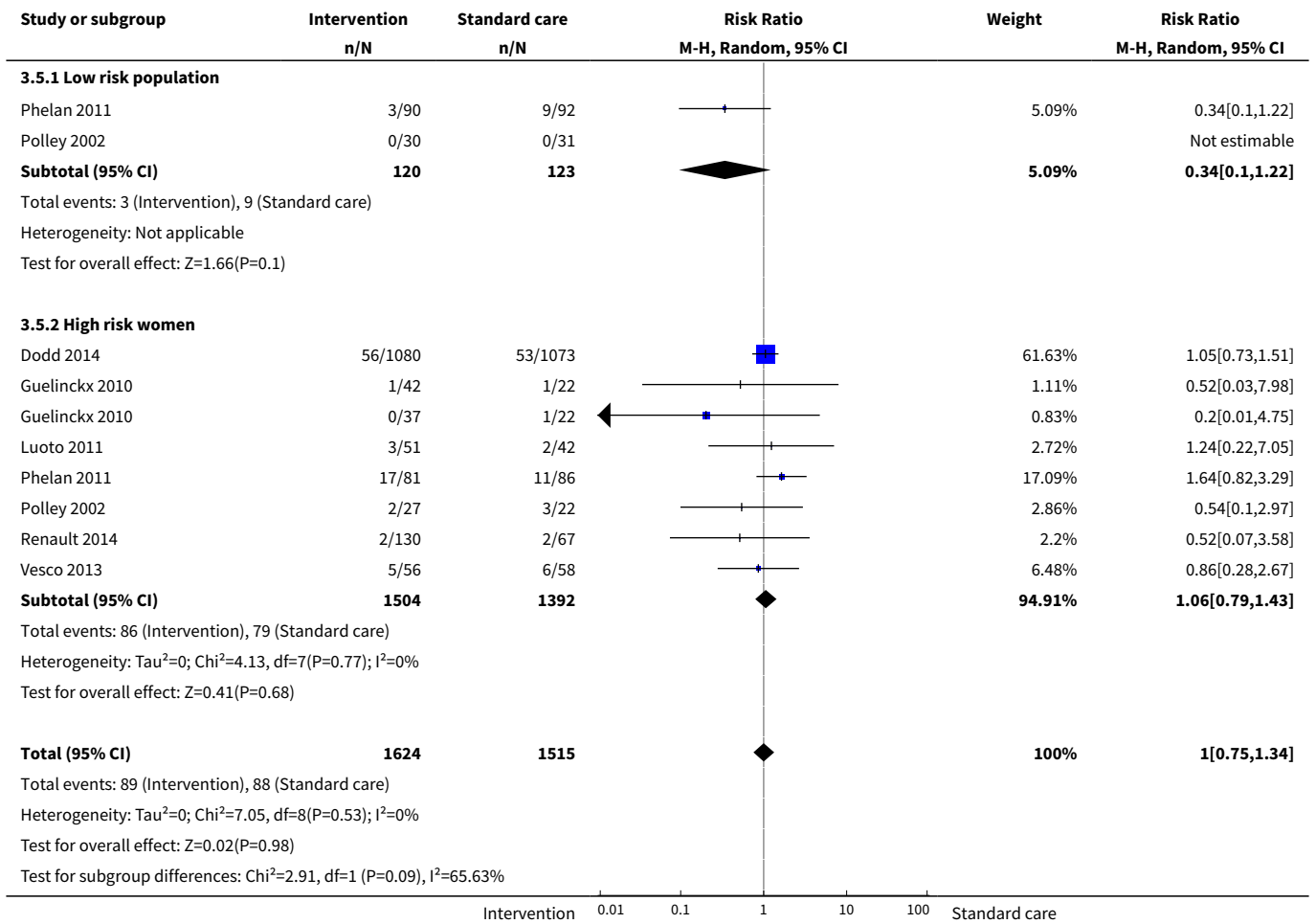


Analysis 3.4. Comparison 3 Diet and exercise counselling vs standard/other care, Outcome 4 Preterm birth.

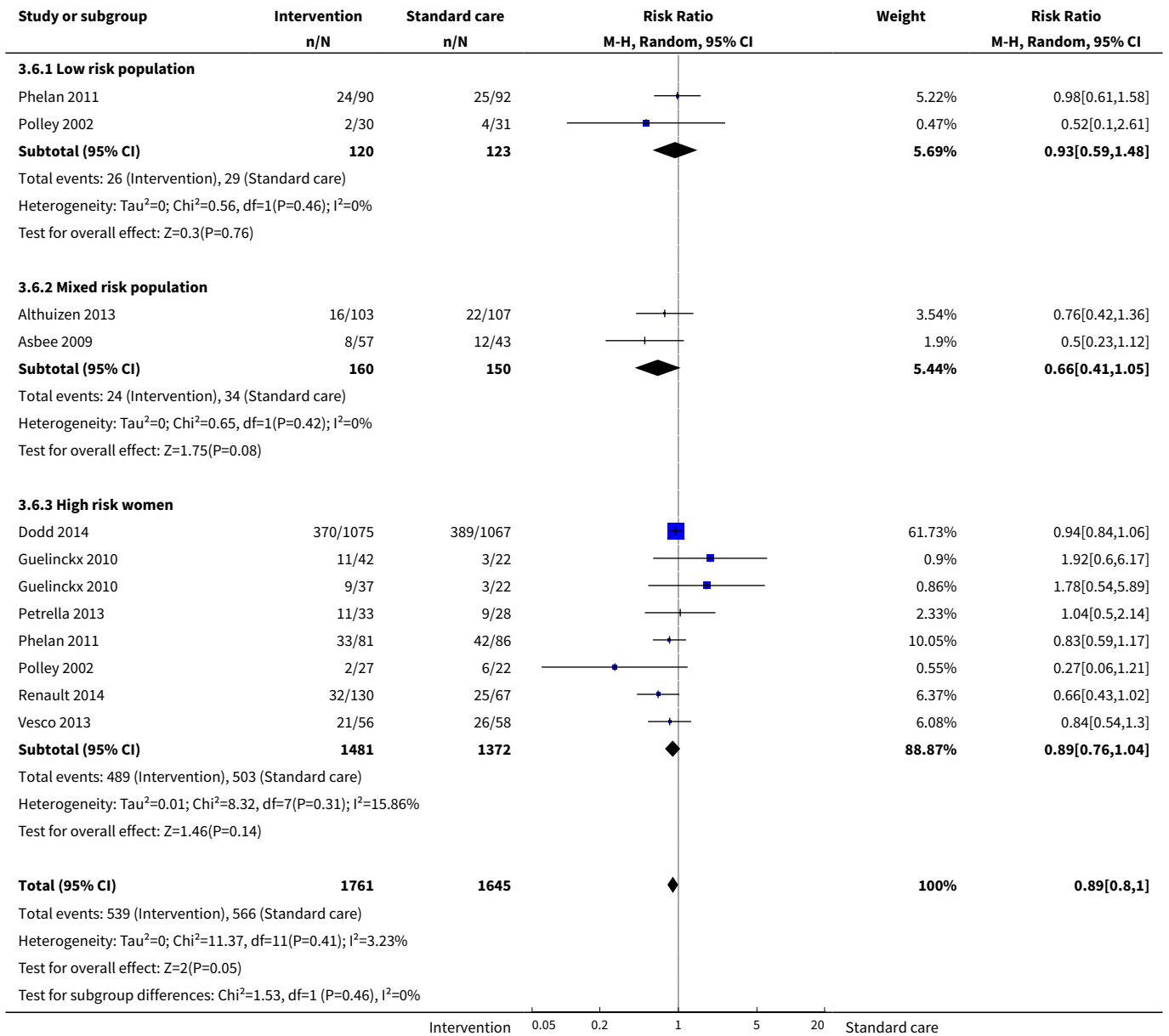




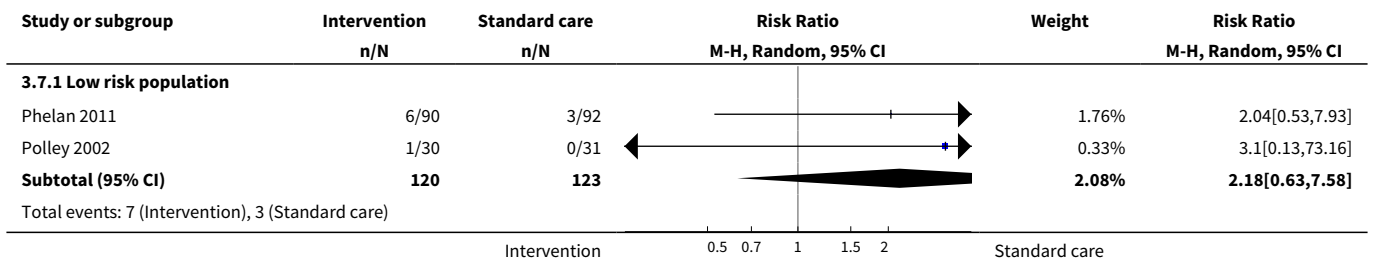
Analysis 3.5. Comparison 3 Diet and exercise counselling vs standard/other care, Outcome 5 Pre-eclampsia.

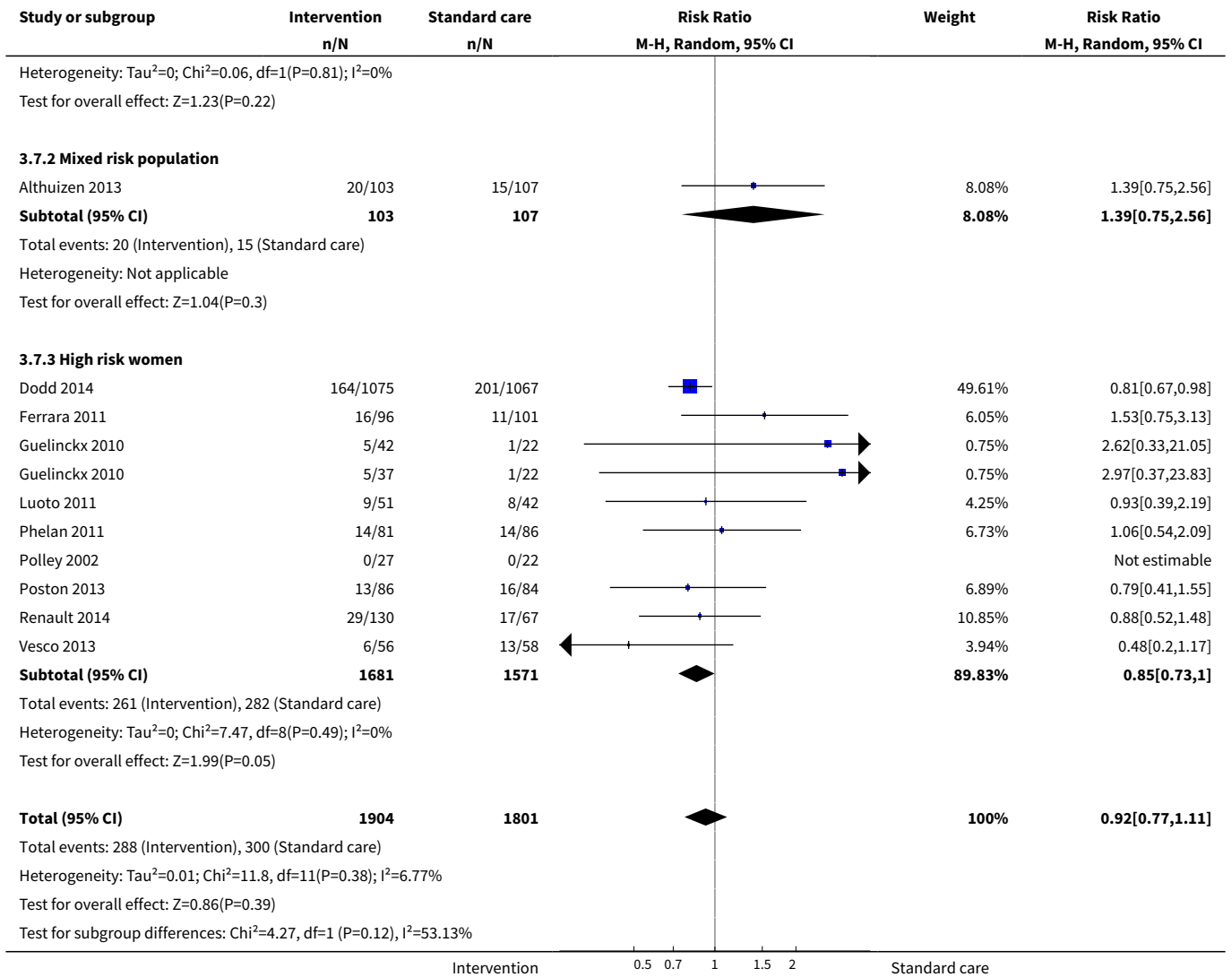


Analysis 3.6. Comparison 3 Diet and exercise counselling vs standard/other care, Outcome 6 Caesarean delivery.



Analysis 3.7. Comparison 3 Diet and exercise counselling vs standard/other care, Outcome 7 Macrosomia (Infant birthweight > 4000 g).





Comparison 4. Exercise vs standard/other care

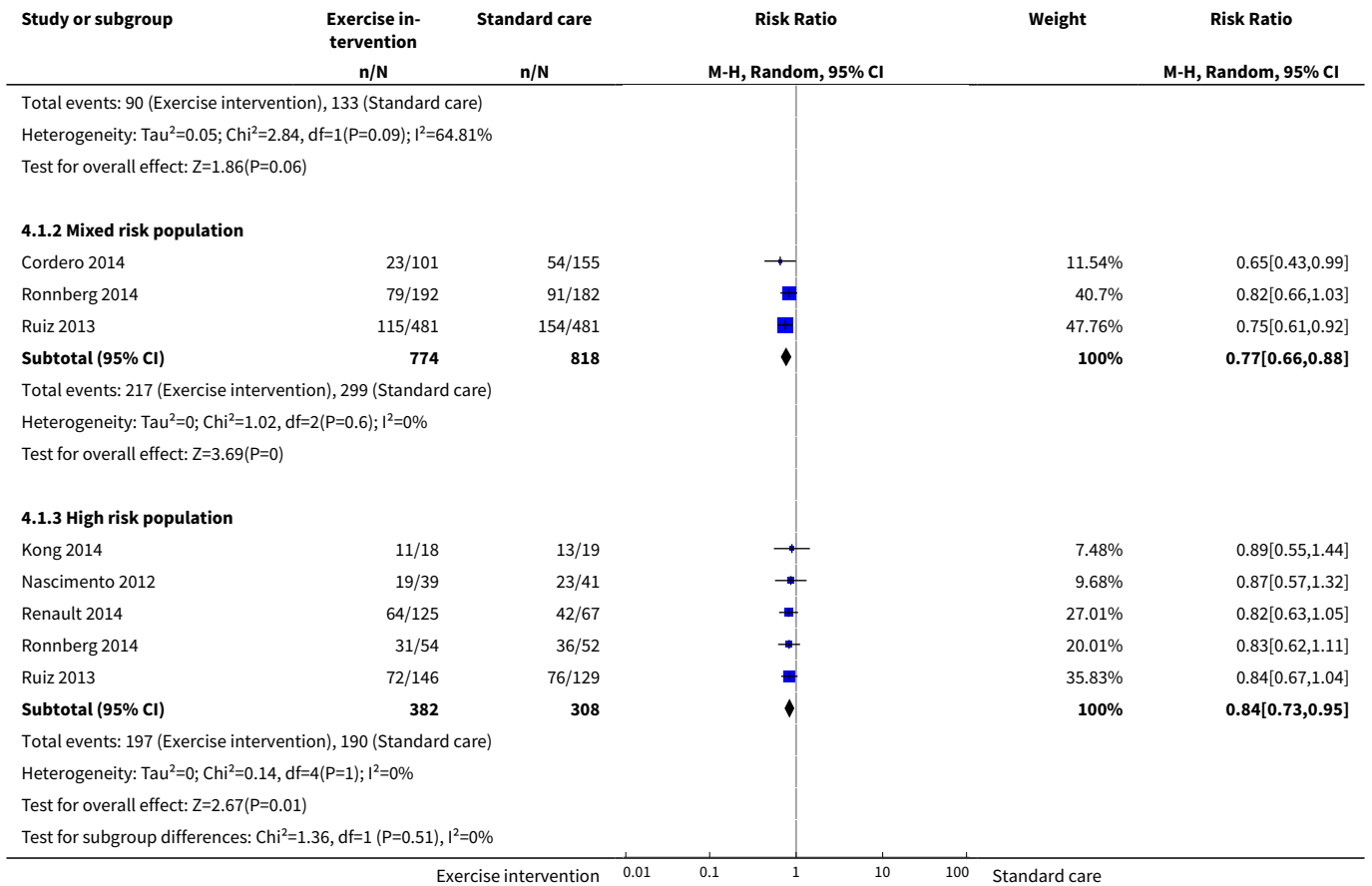
Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
1 Excessive weight gain	6		Risk Ratio (M-H, Random, 95% CI)	Subtotals only
1.1 Low risk population	2	953	Risk Ratio (M-H, Random, 95% CI)	0.69 [0.47, 1.02]
1.2 Mixed risk population	3	1592	Risk Ratio (M-H, Random, 95% CI)	0.77 [0.66, 0.88]
1.3 High risk population	5	690	Risk Ratio (M-H, Random, 95% CI)	0.84 [0.73, 0.95]
2 Weight gain (kg)	8		Mean Difference (IV, Random, 95% CI)	Subtotals only
2.1 Low risk population	1	687	Mean Difference (IV, Random, 95% CI)	-1.5 [-2.08, -0.92]
2.2 Mixed risk population	4	1196	Mean Difference (IV, Random, 95% CI)	-1.00 [-2.01, 0.01]

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
2.3 High risk women	5	548	Mean Difference (IV, Random, 95% CI)	-0.34 [-1.15, 0.47]
3 Low weight gain	4		Risk Ratio (M-H, Random, 95% CI)	Subtotals only
3.1 Low risk population	1	687	Risk Ratio (M-H, Random, 95% CI)	1.29 [1.06, 1.58]
3.2 Mixed risk population	2	1336	Risk Ratio (M-H, Random, 95% CI)	1.20 [1.00, 1.43]
3.3 High risk population	3	504	Risk Ratio (M-H, Random, 95% CI)	1.03 [0.66, 1.60]
4 Preterm birth	5		Risk Ratio (M-H, Random, 95% CI)	Subtotals only
4.1 Low risk population	1	687	Risk Ratio (M-H, Random, 95% CI)	4.20 [0.90, 19.65]
4.2 Mixed risk population	3	1129	Risk Ratio (M-H, Random, 95% CI)	1.92 [0.75, 4.93]
4.3 High risk population	3	504	Risk Ratio (M-H, Random, 95% CI)	1.34 [0.51, 3.55]
5 Pre-eclampsia	4	1253	Risk Ratio (M-H, Random, 95% CI)	0.99 [0.58, 1.66]
5.1 Mixed risk population	2	1024	Risk Ratio (M-H, Random, 95% CI)	0.91 [0.52, 1.60]
5.2 High risk population	2	229	Risk Ratio (M-H, Random, 95% CI)	1.60 [0.38, 6.73]
6 Caesarean delivery	10		Risk Ratio (M-H, Random, 95% CI)	Subtotals only
6.1 Low risk population	1	687	Risk Ratio (M-H, Random, 95% CI)	0.88 [0.63, 1.21]
6.2 Mixed risk population	6	2263	Risk Ratio (M-H, Random, 95% CI)	0.96 [0.76, 1.22]
6.3 High risk population	5	645	Risk Ratio (M-H, Random, 95% CI)	0.98 [0.81, 1.20]
7 Macrosomia (Infant birthweight > 4000 g)	9		Risk Ratio (M-H, Random, 95% CI)	Subtotals only
7.1 Low risk population	1	687	Risk Ratio (M-H, Random, 95% CI)	0.60 [0.26, 1.41]
7.2 Mixed risk population	7	2445	Risk Ratio (M-H, Random, 95% CI)	0.81 [0.64, 1.02]
7.3 High risk population	3	504	Risk Ratio (M-H, Random, 95% CI)	0.65 [0.22, 1.91]

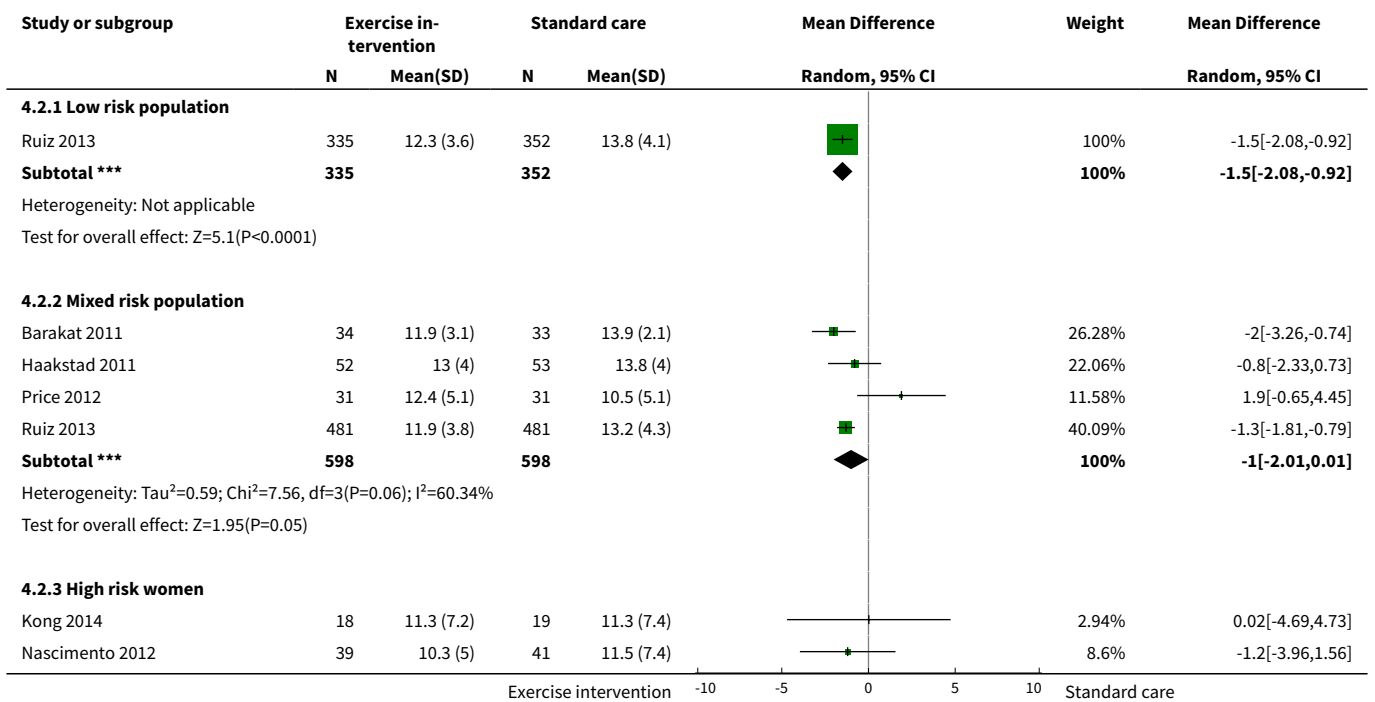
Analysis 4.1. Comparison 4 Exercise vs standard/other care, Outcome 1 Excessive weight gain.

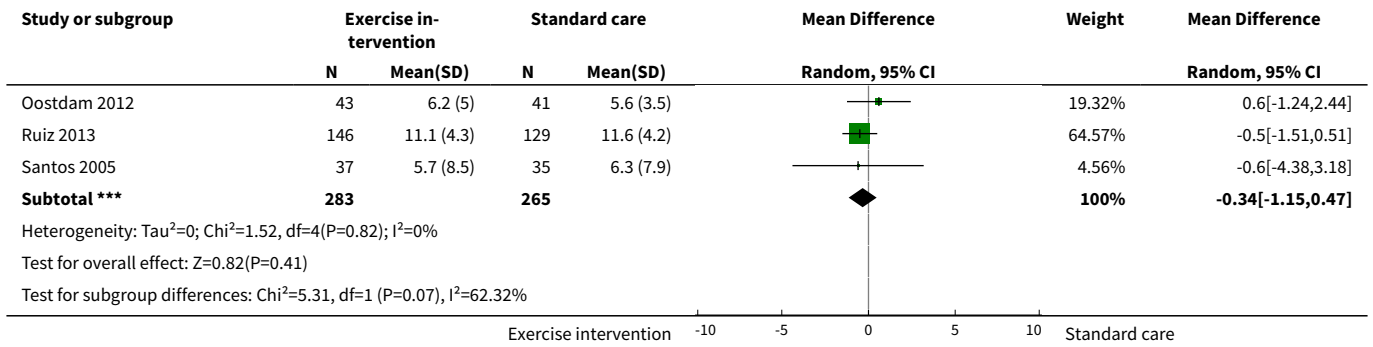
Study or subgroup	Exercise intervention	Standard care	Risk Ratio M-H, Random, 95% CI	Weight	Risk Ratio M-H, Random, 95% CI
	n/N	n/N			
4.1.1 Low risk population					
Ronnberg 2014	48/136	55/130		52.2%	0.83[0.62,1.13]
Ruiz 2013	42/335	78/352		47.8%	0.57[0.4,0.8]
Subtotal (95% CI)	471	482		100%	0.69[0.47,1.02]

Exercise intervention 0.01 0.1 1 10 100 Standard care

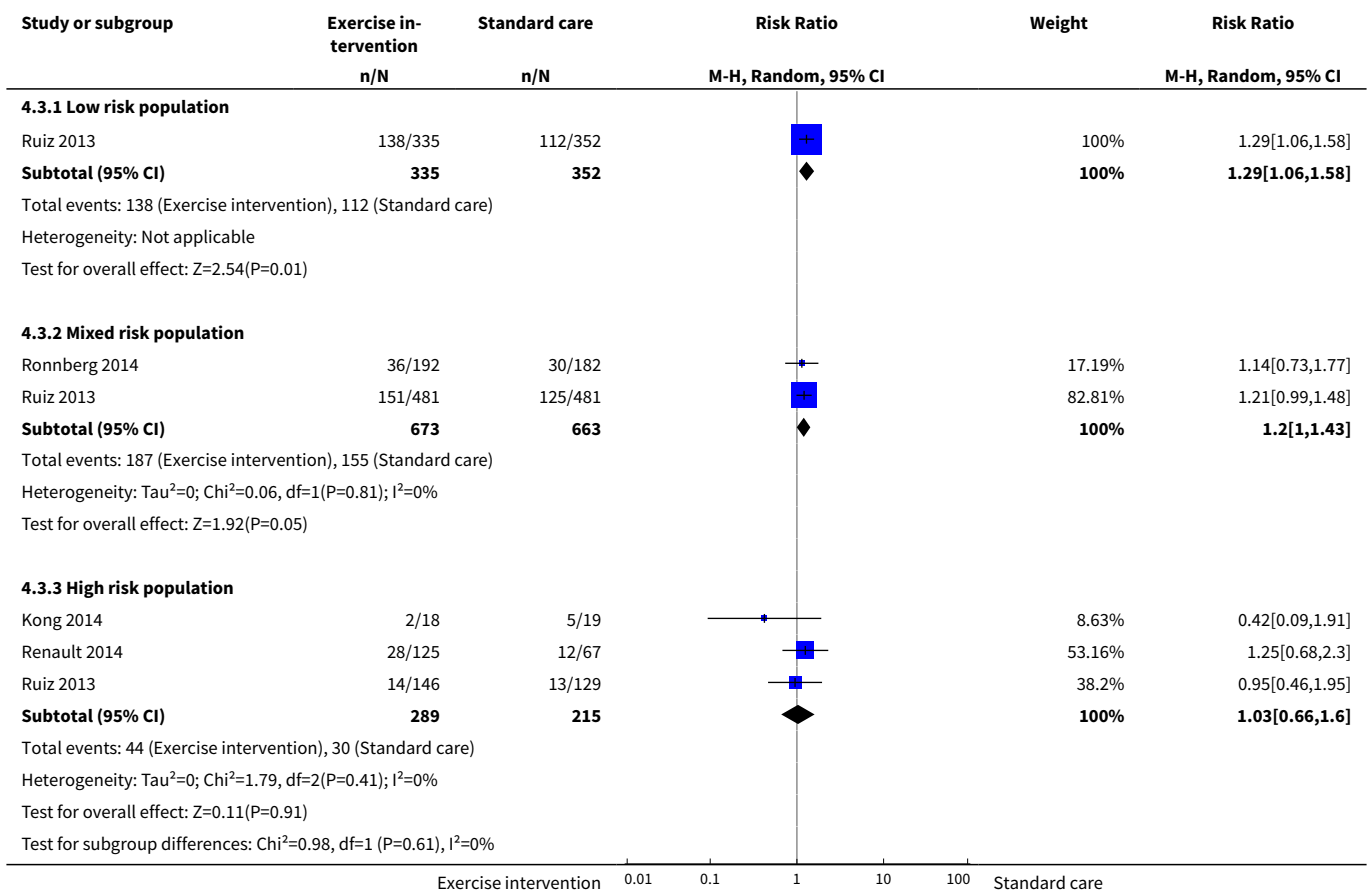


Analysis 4.2. Comparison 4 Exercise vs standard/other care, Outcome 2 Weight gain (kg).

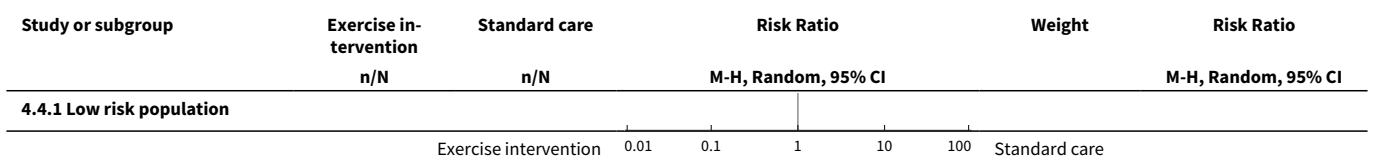


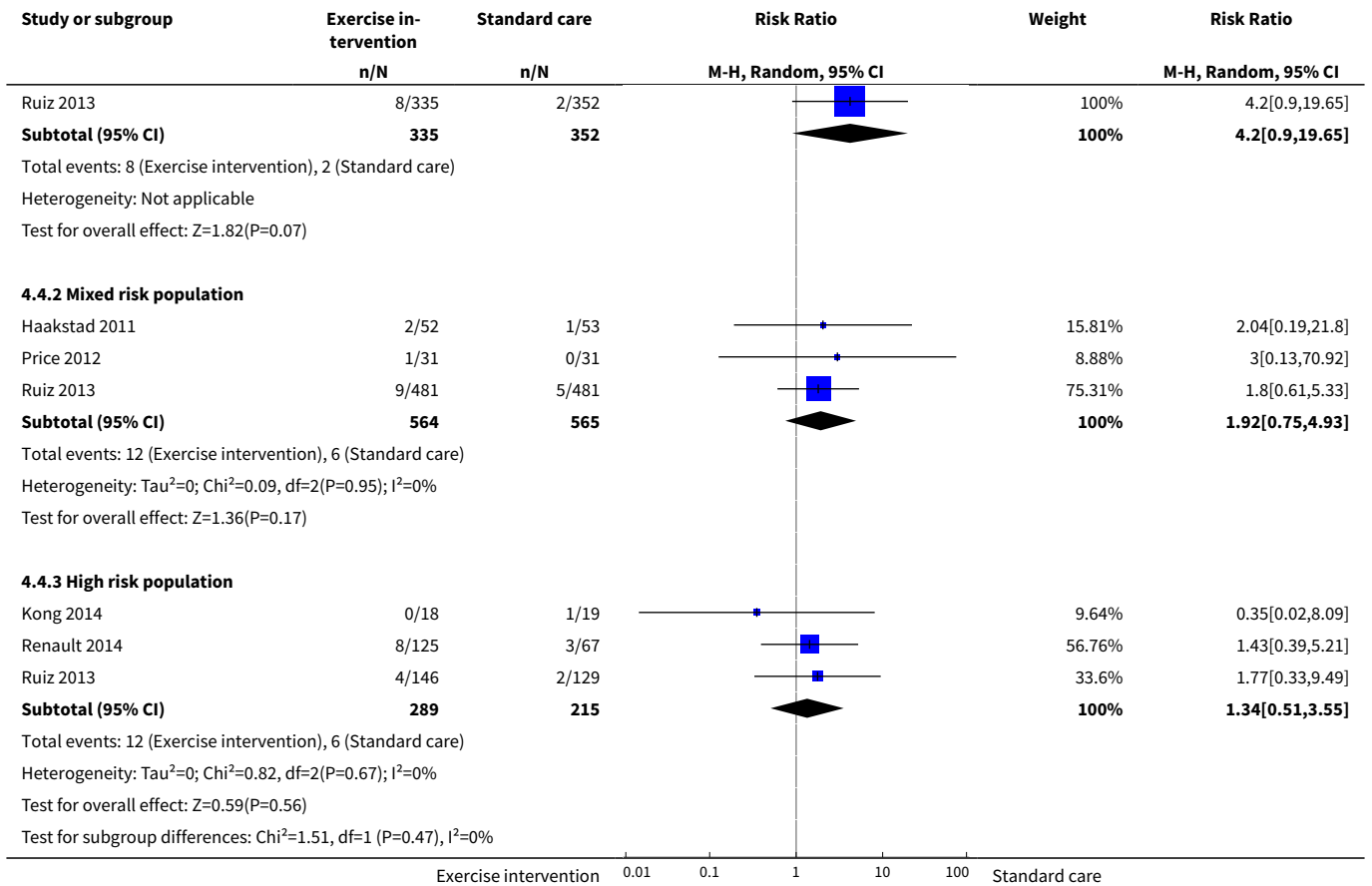


Analysis 4.3. Comparison 4 Exercise vs standard/other care, Outcome 3 Low weight gain.

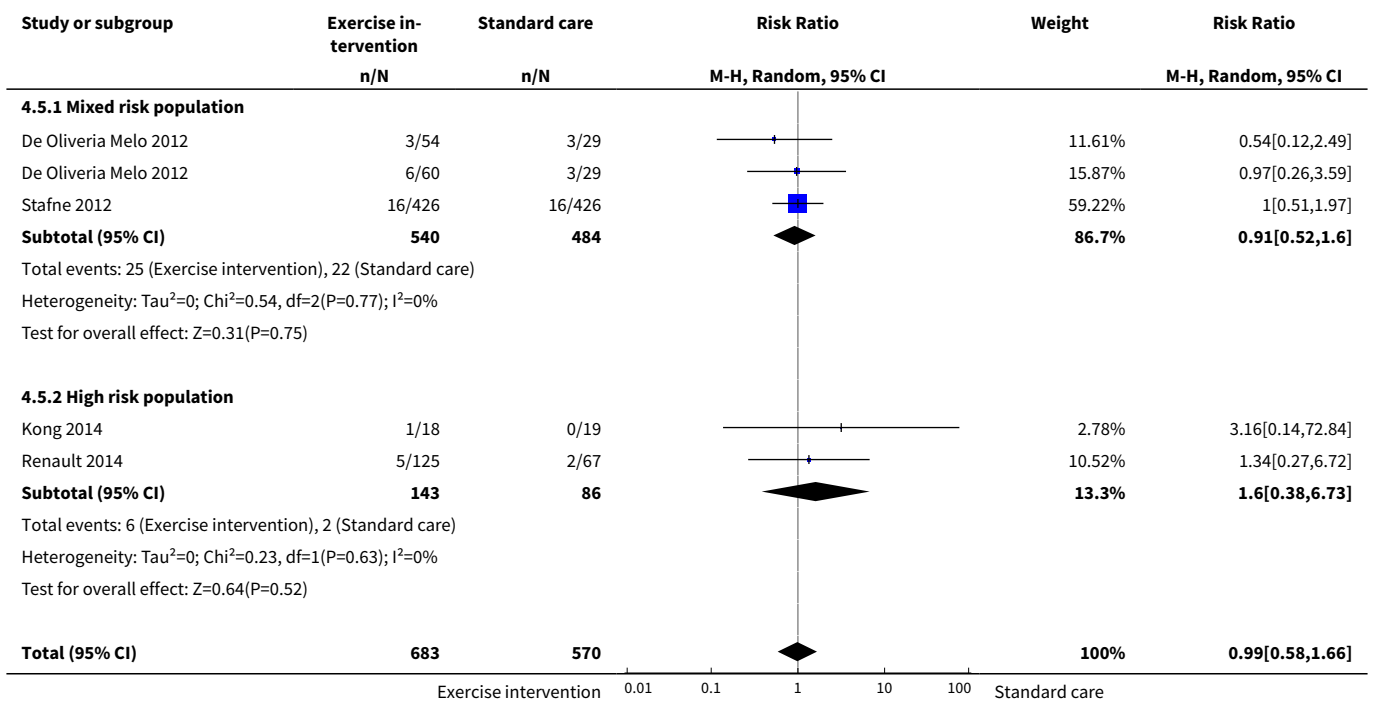


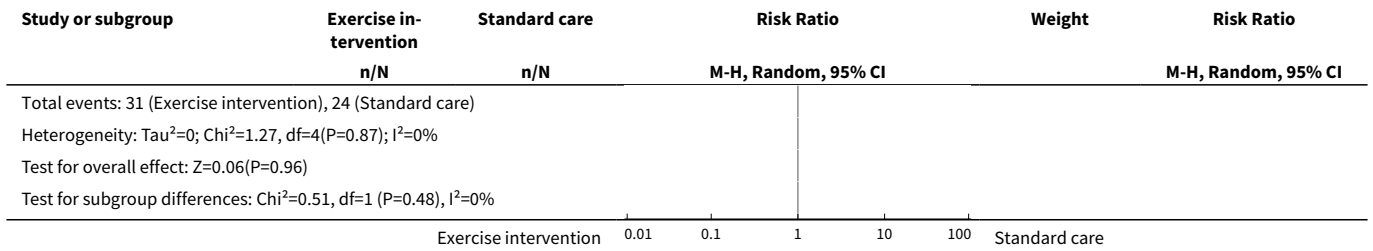
Analysis 4.4. Comparison 4 Exercise vs standard/other care, Outcome 4 Preterm birth.



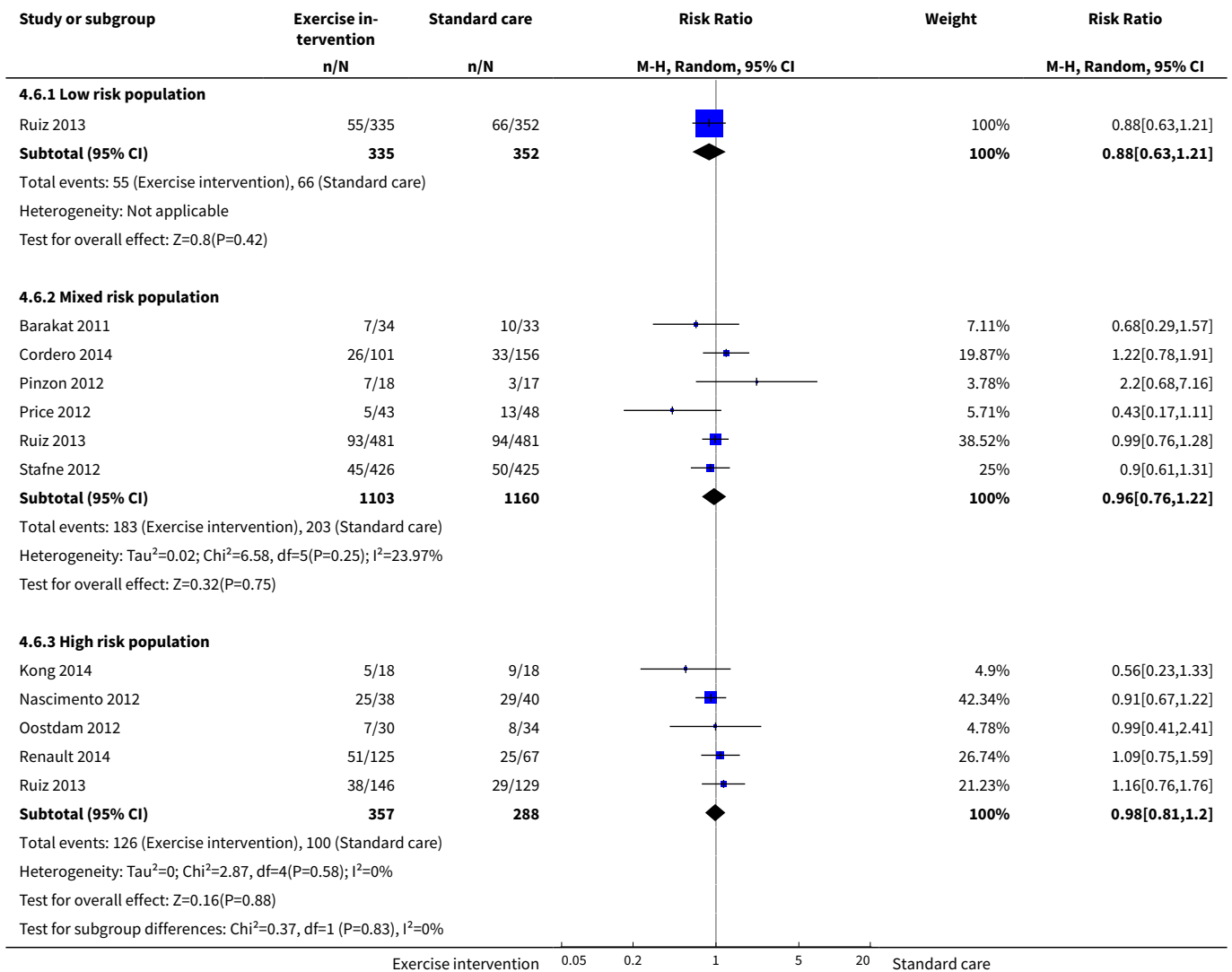


Analysis 4.5. Comparison 4 Exercise vs standard/other care, Outcome 5 Pre-eclampsia.

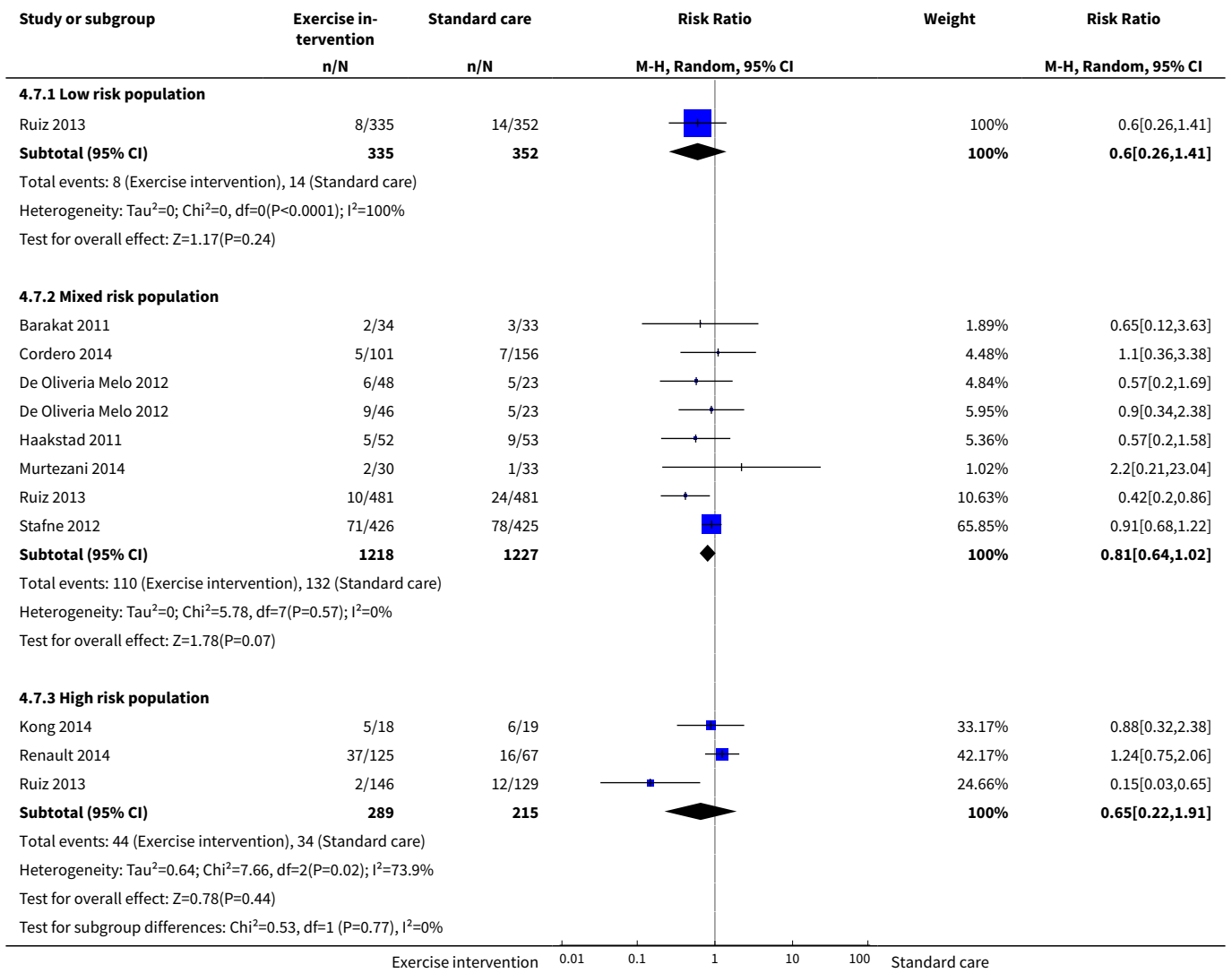




Analysis 4.6. Comparison 4 Exercise vs standard/other care, Outcome 6 Caesarean delivery.



Analysis 4.7. Comparison 4 Exercise vs standard/other care, Outcome 7 Macrosomia (Infant birthweight > 4000 g).

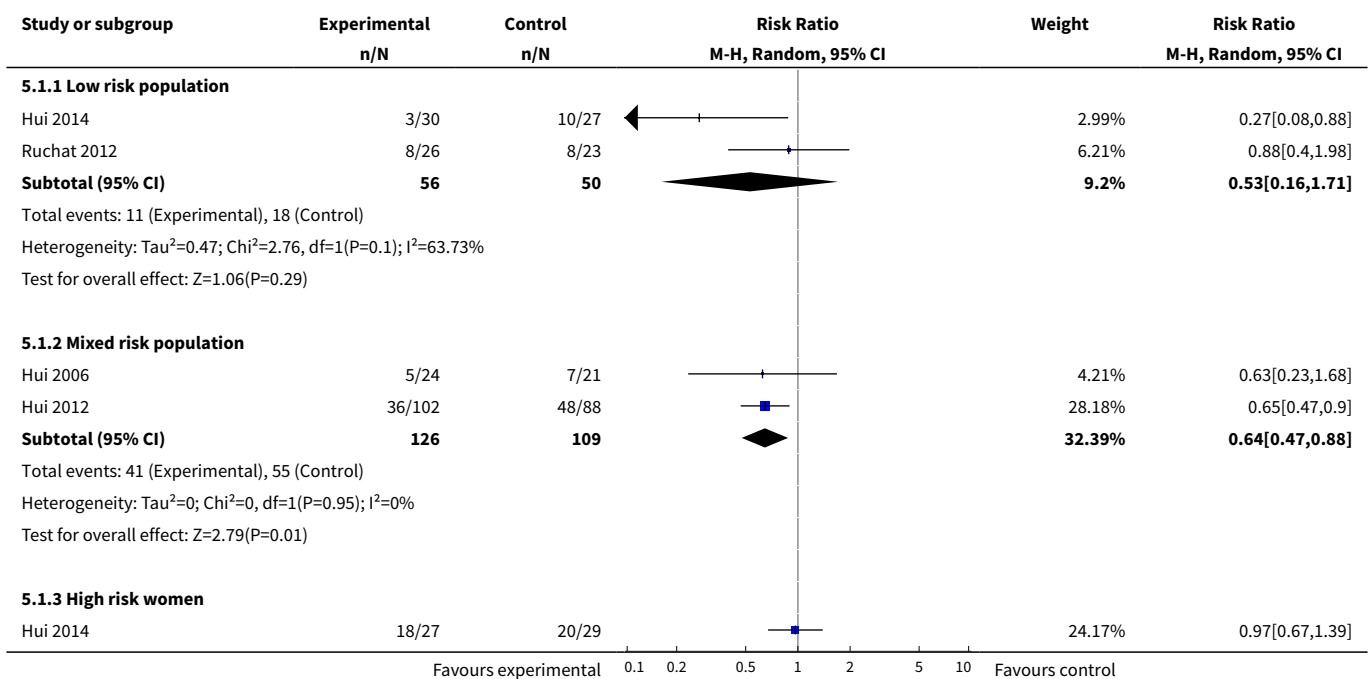


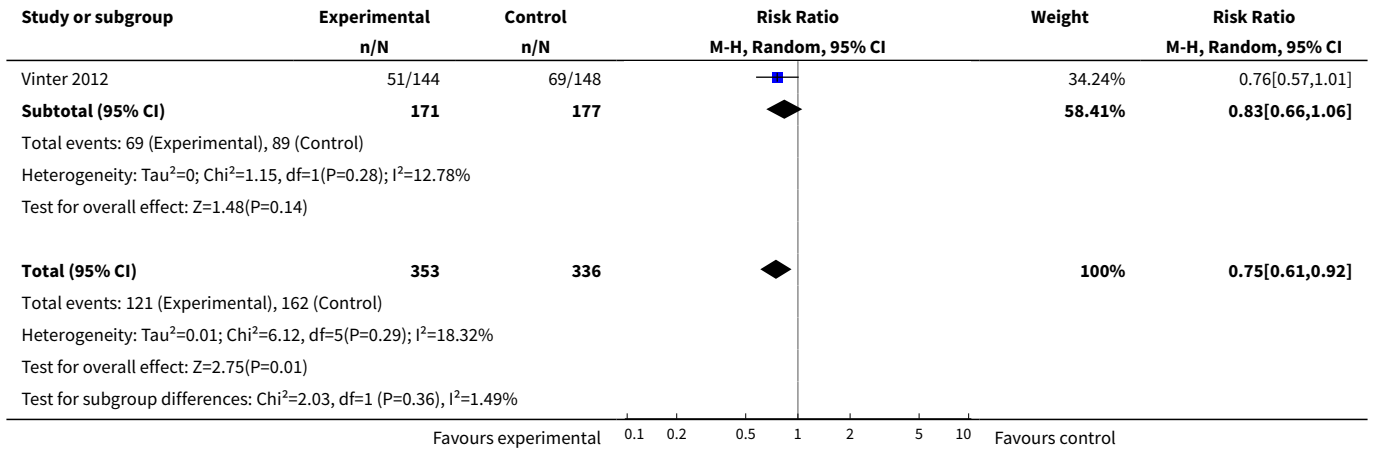
Comparison 5. Diet and supervised exercise vs standard/other care

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
1 Excessive weight gain	5	689	Risk Ratio (M-H, Random, 95% CI)	0.75 [0.61, 0.92]
1.1 Low risk population	2	106	Risk Ratio (M-H, Random, 95% CI)	0.53 [0.16, 1.71]
1.2 Mixed risk population	2	235	Risk Ratio (M-H, Random, 95% CI)	0.64 [0.47, 0.88]
1.3 High risk women	2	348	Risk Ratio (M-H, Random, 95% CI)	0.83 [0.66, 1.06]
2 Weight gain (kg)	3	348	Mean Difference (IV, Random, 95% CI)	-1.31 [-1.00, 0.37]
2.1 Low risk population	1	57	Mean Difference (IV, Random, 95% CI)	-3.33 [-5.45, -1.21]

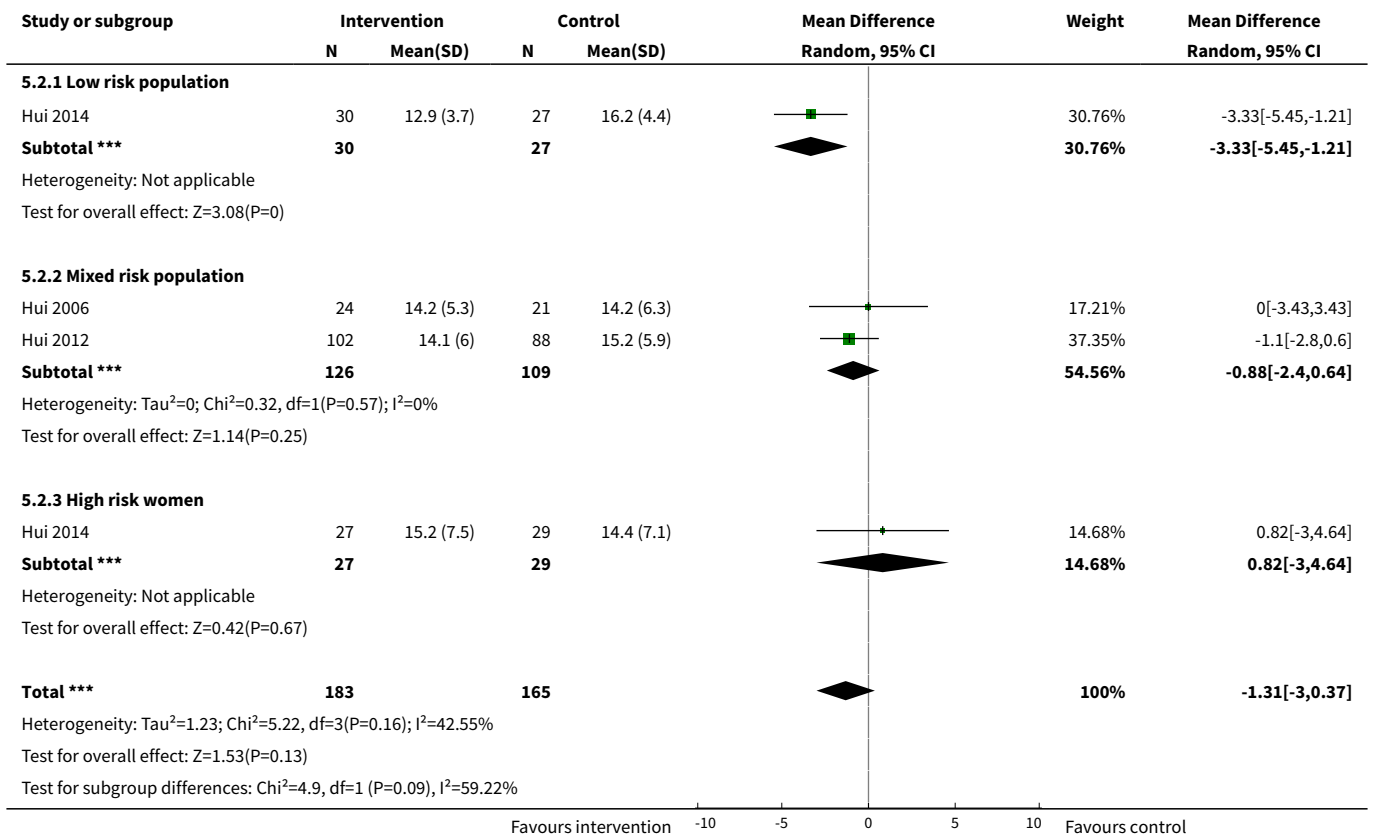
Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
2.2 Mixed risk population	2	235	Mean Difference (IV, Random, 95% CI)	-0.88 [-2.40, 0.64]
2.3 High risk women	1	56	Mean Difference (IV, Random, 95% CI)	0.82 [-1.00, 4.64]
3 Low weight gain	1		Risk Ratio (M-H, Random, 95% CI)	Subtotals only
3.1 Mixed risk population	1	49	Risk Ratio (M-H, Random, 95% CI)	1.47 [0.40, 5.50]
4 Pre-eclampsia	1		Risk Ratio (M-H, Random, 95% CI)	Subtotals only
4.1 High risk women	1	304	Risk Ratio (M-H, Random, 95% CI)	0.84 [0.51, 1.40]
5 Caesarean delivery	3	607	Risk Ratio (M-H, Random, 95% CI)	1.00 [0.69, 1.45]
5.1 Low risk	1	57	Risk Ratio (M-H, Random, 95% CI)	0.0 [0.0, 0.0]
5.2 Mixed risk population	1	190	Risk Ratio (M-H, Random, 95% CI)	0.58 [0.10, 3.36]
5.3 High risk women	2	360	Risk Ratio (M-H, Random, 95% CI)	0.97 [0.48, 1.96]
6 Macrosomia (Infant birthweight > 4000 g)	3	398	Risk Ratio (M-H, Random, 95% CI)	1.02 [0.71, 1.46]
6.1 Mixed risk population	2	94	Risk Ratio (M-H, Random, 95% CI)	0.74 [0.23, 2.35]
6.2 High risk women	1	304	Risk Ratio (M-H, Random, 95% CI)	1.05 [0.72, 1.54]

Analysis 5.1. Comparison 5 Diet and supervised exercise vs standard/other care, Outcome 1 Excessive weight gain.

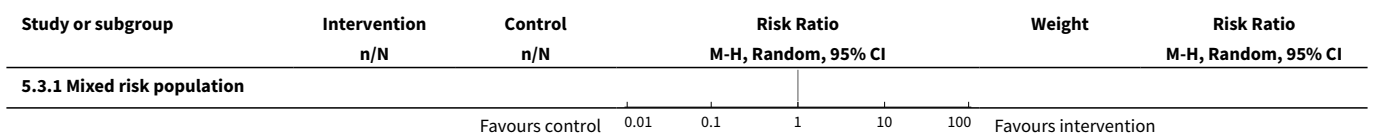


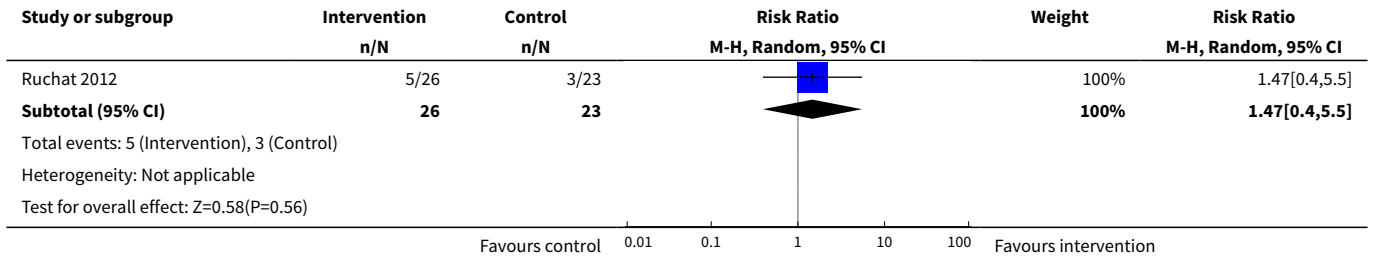


Analysis 5.2. Comparison 5 Diet and supervised exercise vs standard/other care, Outcome 2 Weight gain (kg).

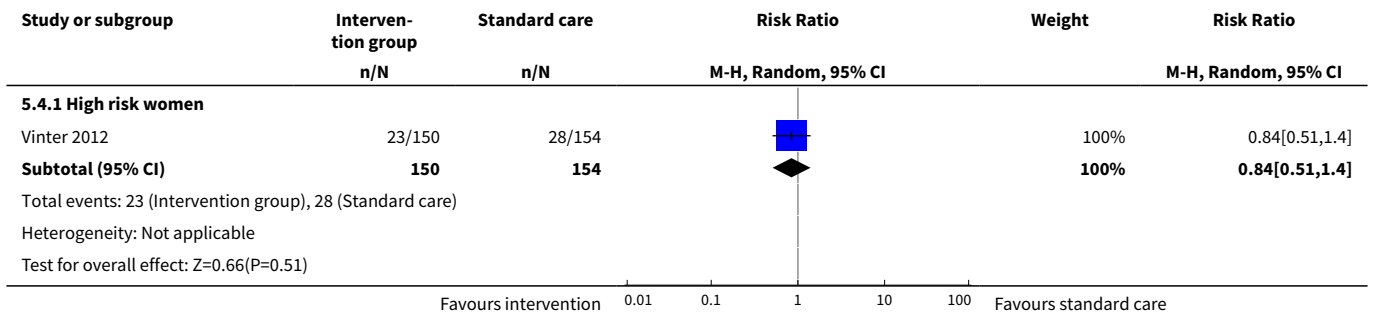


Analysis 5.3. Comparison 5 Diet and supervised exercise vs standard/other care, Outcome 3 Low weight gain.

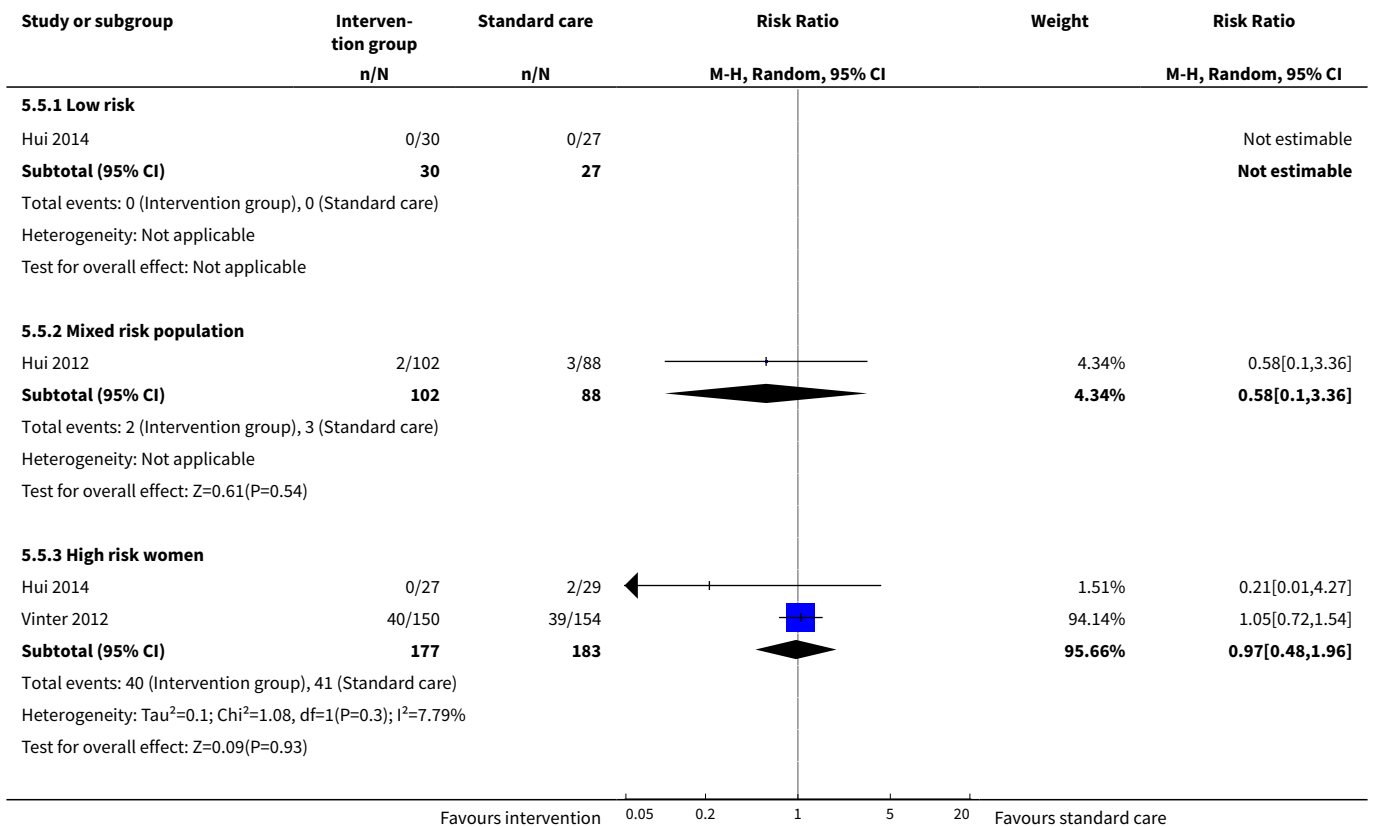


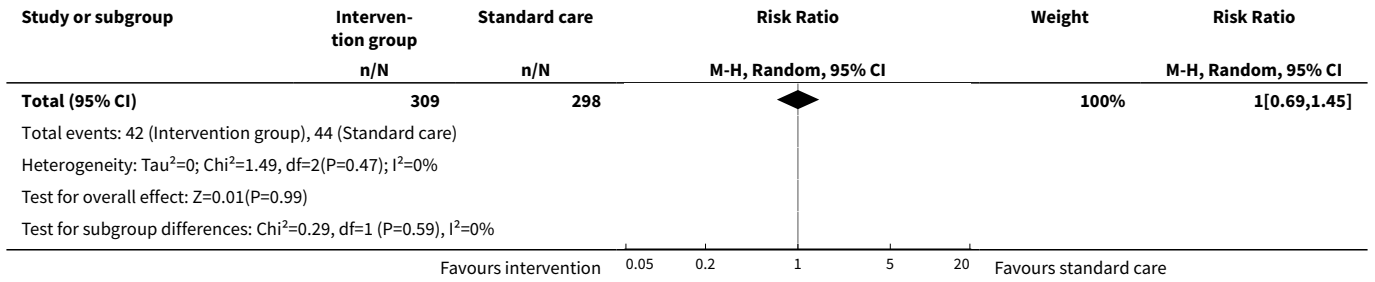


Analysis 5.4. Comparison 5 Diet and supervised exercise vs standard/other care, Outcome 4 Pre-eclampsia.

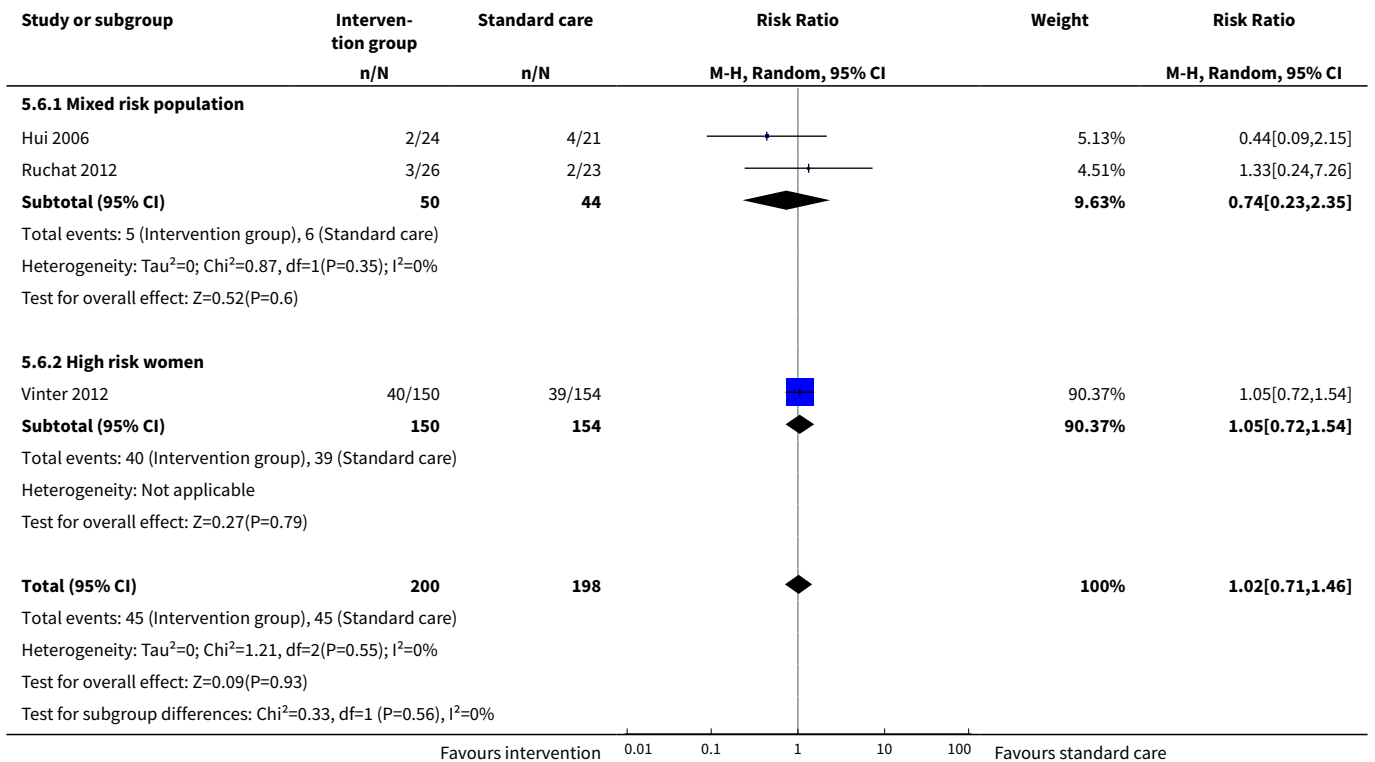


Analysis 5.5. Comparison 5 Diet and supervised exercise vs standard/other care, Outcome 5 Caesarean delivery.





Analysis 5.6. Comparison 5 Diet and supervised exercise vs standard/other care, Outcome 6 Macrosomia (Infant birthweight > 4000 g).

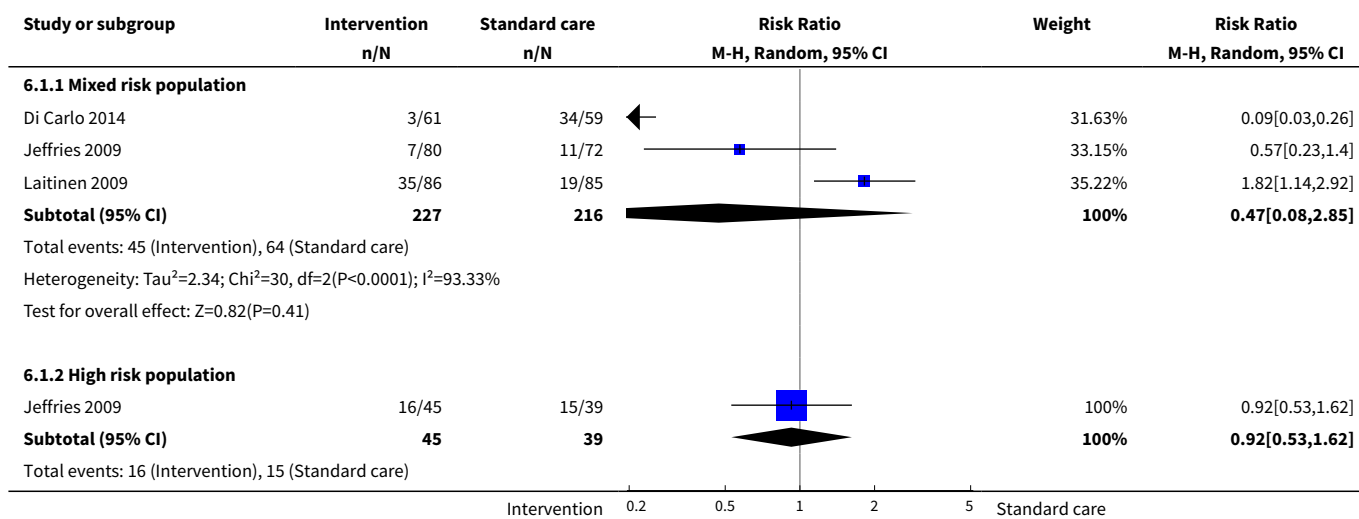


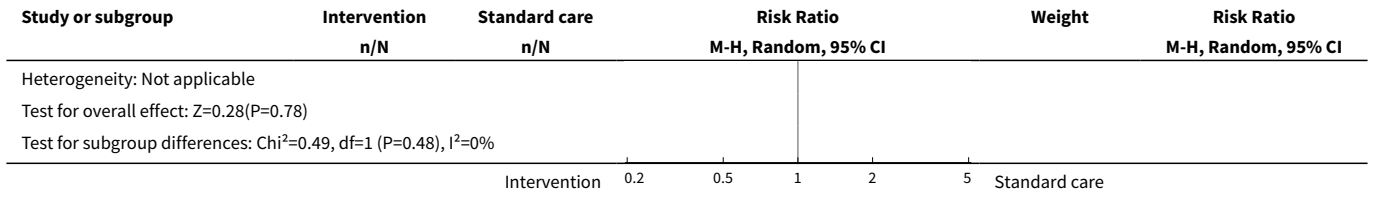
Comparison 6. Diet counselling/other vs standard/other care

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
1 Excessive weight gain	3		Risk Ratio (M-H, Random, 95% CI)	Subtotals only
1.1 Mixed risk population	3	443	Risk Ratio (M-H, Random, 95% CI)	0.47 [0.08, 2.85]
1.2 High risk population	1	84	Risk Ratio (M-H, Random, 95% CI)	0.92 [0.53, 1.62]
2 Weight gain (kg)	7		Mean Difference (IV, Random, 95% CI)	Totals not selected

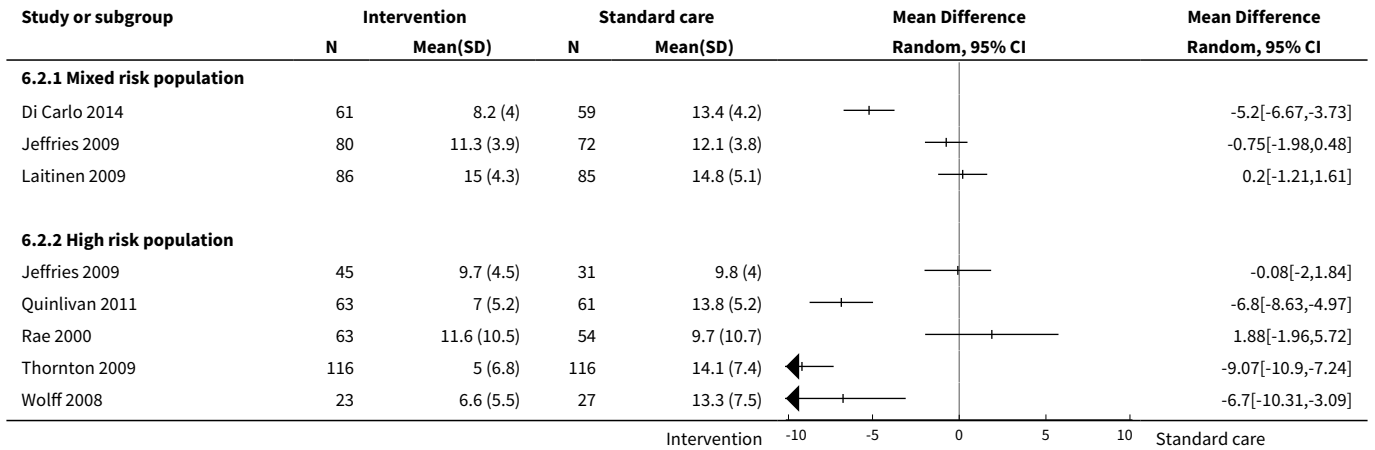
Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
2.1 Mixed risk population	3		Mean Difference (IV, Random, 95% CI)	0.0 [0.0, 0.0]
2.2 High risk population	5		Mean Difference (IV, Random, 95% CI)	0.0 [0.0, 0.0]
3 Low weight gain	1		Risk Ratio (M-H, Fixed, 95% CI)	Totals not selected
3.1 Mixed risk population	1		Risk Ratio (M-H, Fixed, 95% CI)	0.0 [0.0, 0.0]
4 Preterm birth	3	591	Risk Ratio (M-H, Random, 95% CI)	0.67 [0.26, 1.73]
4.1 Mixed risk population	1	235	Risk Ratio (M-H, Random, 95% CI)	0.67 [0.15, 2.93]
4.2 High risk population	2	356	Risk Ratio (M-H, Random, 95% CI)	0.66 [0.19, 2.32]
5 Pre-eclampsia	4	634	Risk Ratio (M-H, Random, 95% CI)	0.90 [0.54, 1.48]
5.1 Mixed risk population	1	235	Risk Ratio (M-H, Random, 95% CI)	2.69 [0.55, 13.03]
5.2 High risk population	3	399	Risk Ratio (M-H, Random, 95% CI)	0.80 [0.47, 1.35]
6 Caesarean delivery	5	754	Risk Ratio (M-H, Random, 95% CI)	1.06 [0.93, 1.21]
6.1 Mixed risk population	2	355	Risk Ratio (M-H, Random, 95% CI)	0.96 [0.60, 1.54]
6.2 High risk population	3	399	Risk Ratio (M-H, Random, 95% CI)	1.10 [0.96, 1.27]
7 Macrosomia (Infant birth-weight > 4000 g)	2	349	Risk Ratio (M-H, Random, 95% CI)	1.81 [0.88, 3.72]
7.1 High risk population	2	349	Risk Ratio (M-H, Random, 95% CI)	1.81 [0.88, 3.72]

Analysis 6.1. Comparison 6 Diet counselling/other vs standard/other care, Outcome 1 Excessive weight gain.

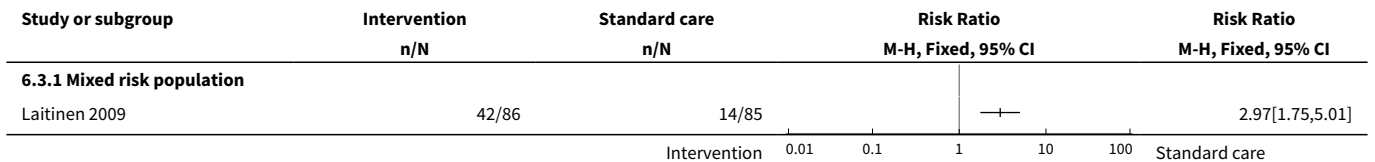




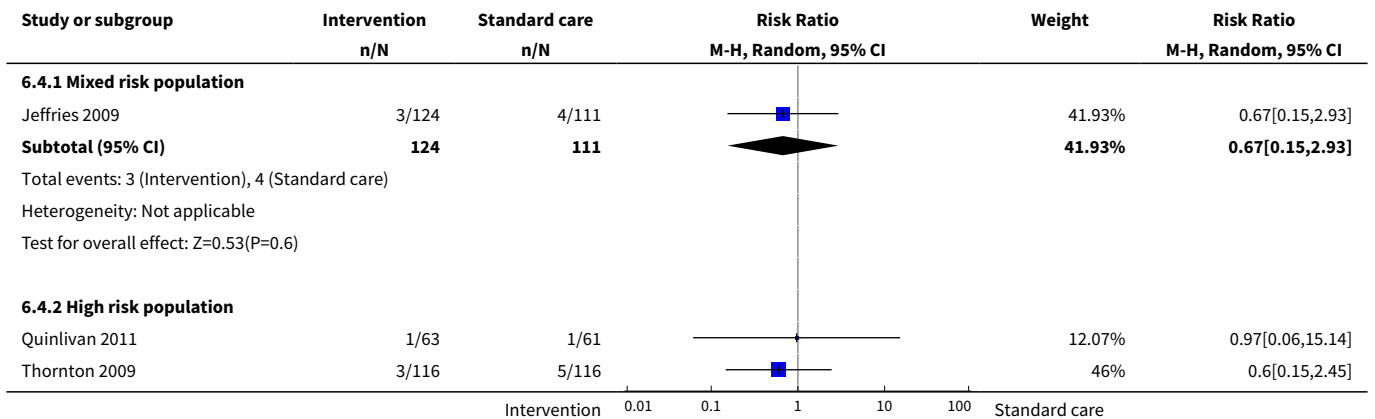
Analysis 6.2. Comparison 6 Diet counselling/other vs standard/other care, Outcome 2 Weight gain (kg).

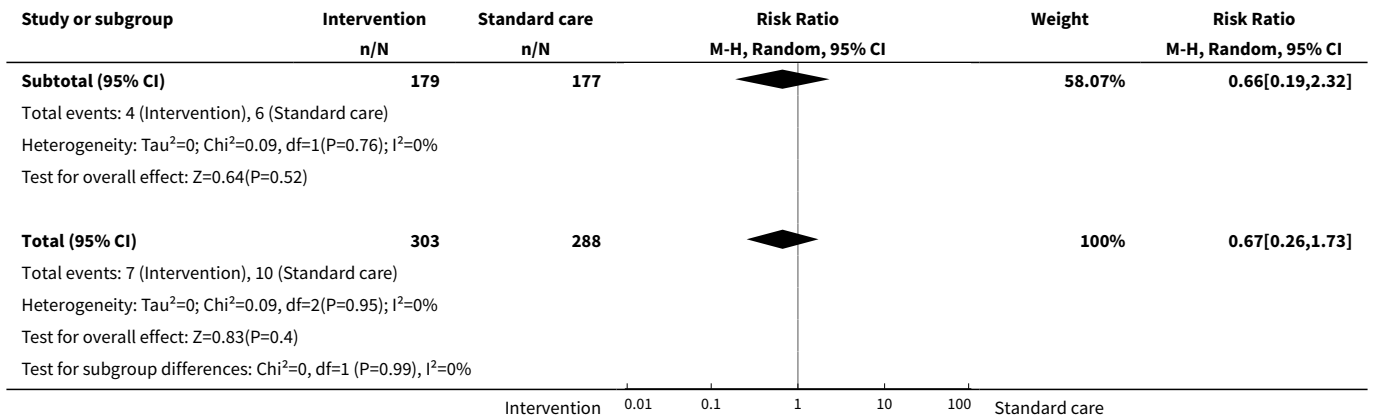


Analysis 6.3. Comparison 6 Diet counselling/other vs standard/other care, Outcome 3 Low weight gain.

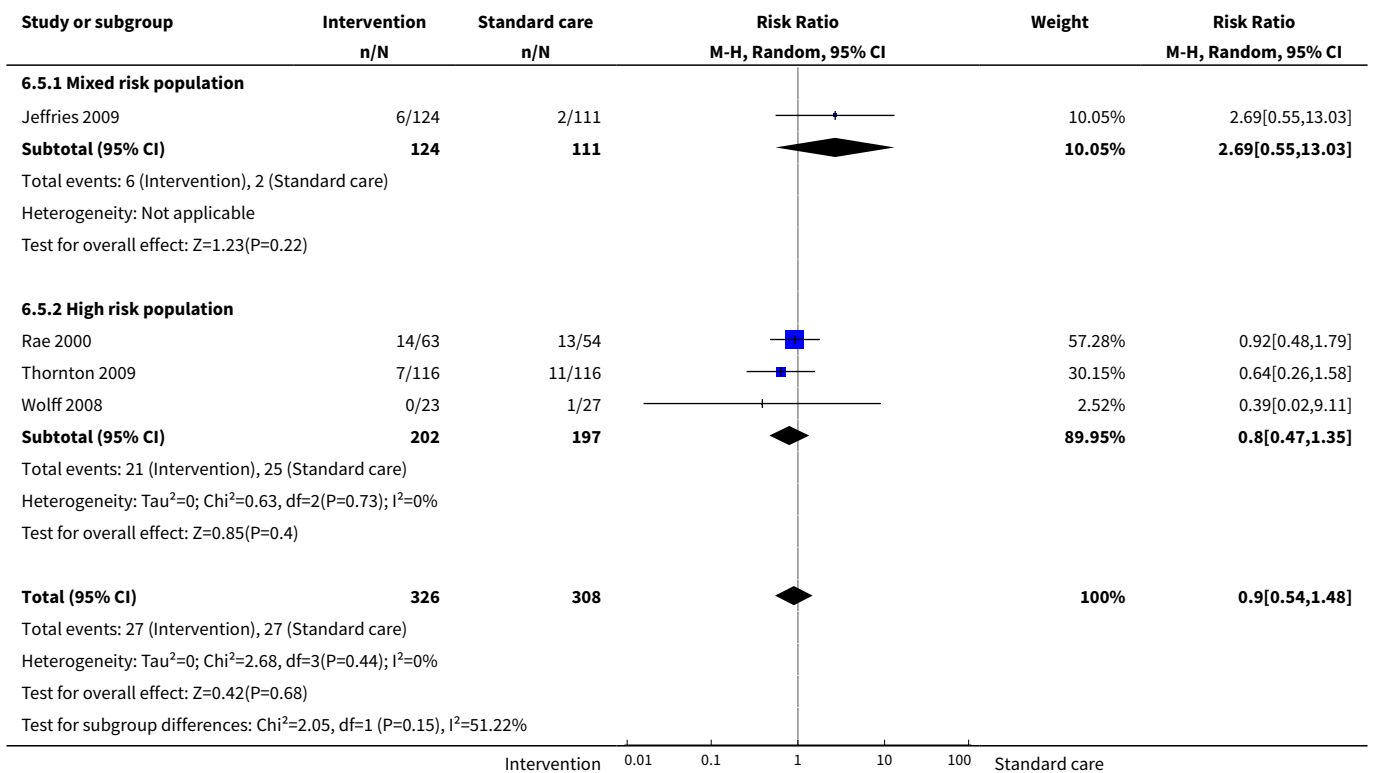


Analysis 6.4. Comparison 6 Diet counselling/other vs standard/other care, Outcome 4 Preterm birth.

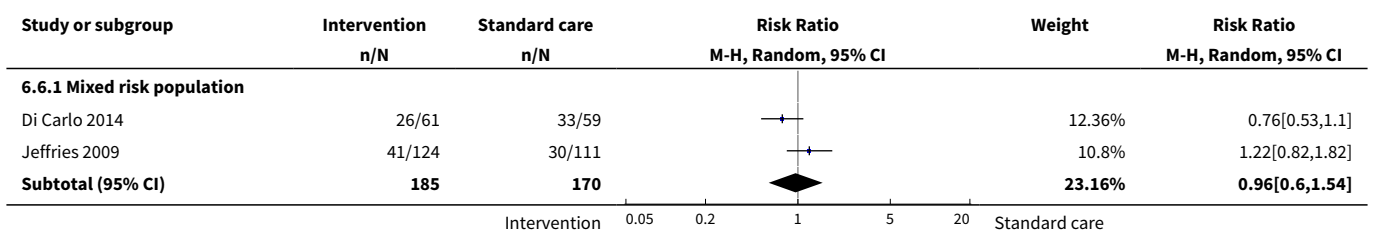


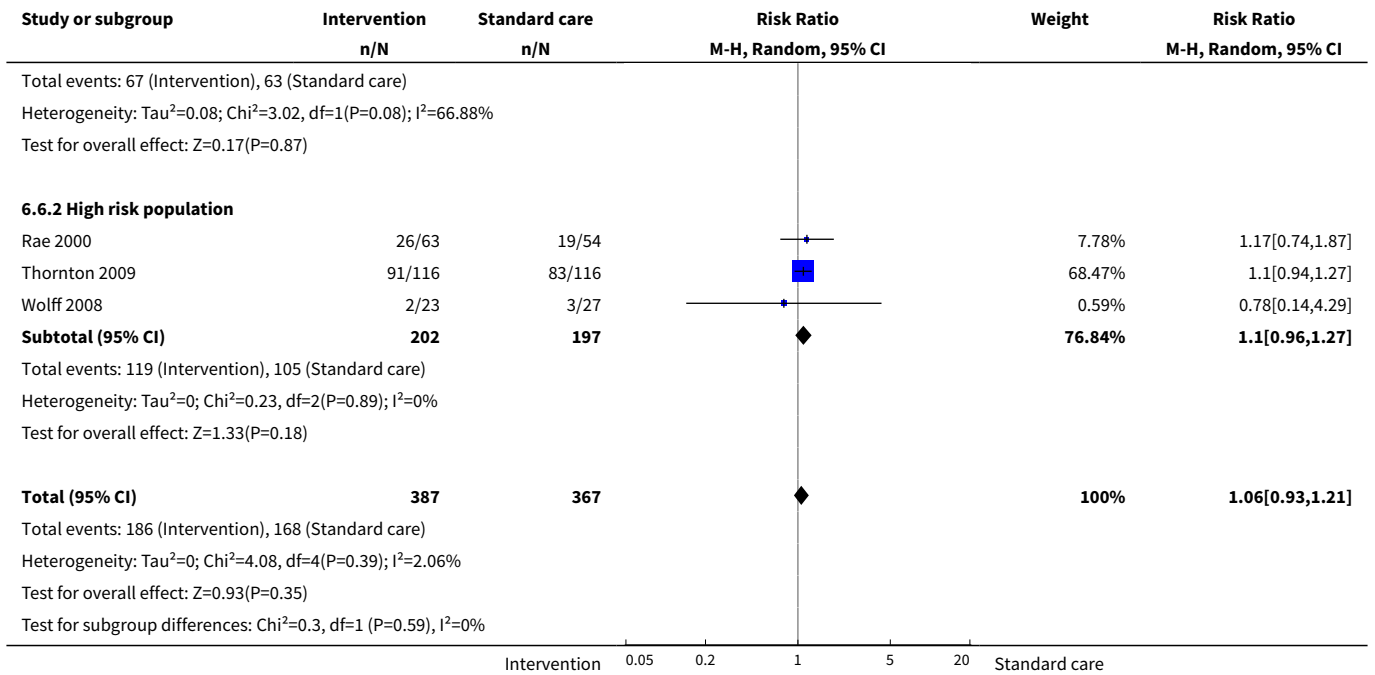


Analysis 6.5. Comparison 6 Diet counselling/other vs standard/other care, Outcome 5 Pre-eclampsia.

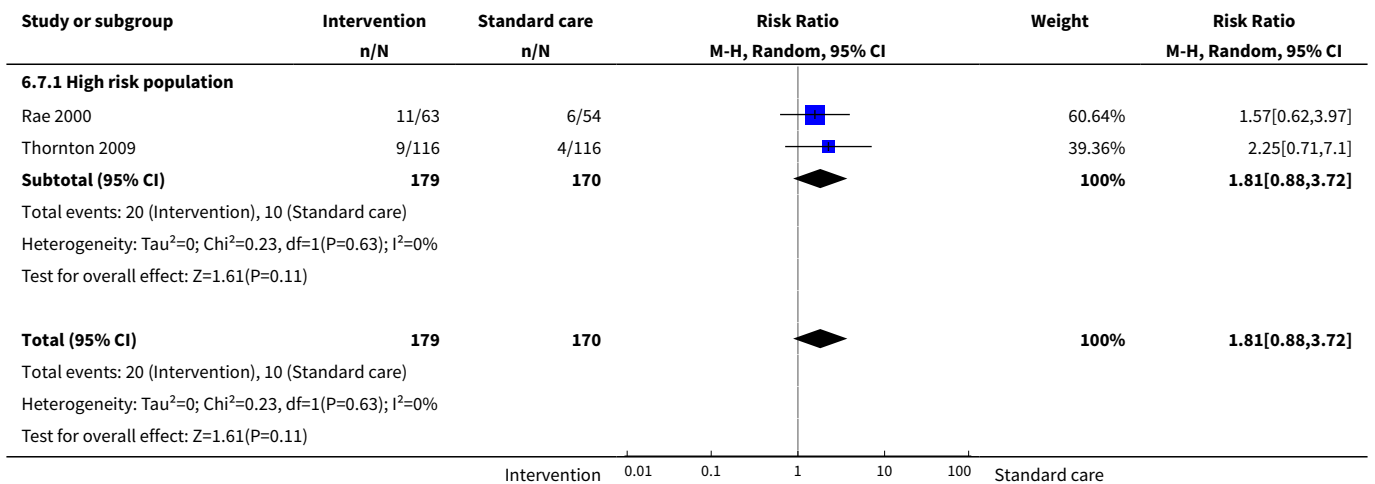


Analysis 6.6. Comparison 6 Diet counselling/other vs standard/other care, Outcome 6 Caesarean delivery.





Analysis 6.7. Comparison 6 Diet counselling/other vs standard/other care, Outcome 7 Macrosomia (Infant birthweight > 4000 g).



ADDITIONAL TABLES

Table 1. Types of Interventions assessed in studies contributing data

Number	Study ID	Experimental intervention (unless otherwise stated, the control intervention was routine care)	Participants analysed	Contributed data		
				Low risk	Mixed risk	High risk
Diet counselling/other						

Table 1. Types of Interventions assessed in studies contributing data (Continued)

1	Di Carlo 2014	The intervention involved a supervised personalised diet plan meeting both personal preferences and specific gestational needs with the average caloric intake being 1916 kcal. The only fat allowed was olive oil. Participants in the intervention group underwent monthly follow-up appointments with a dietician who monitored their weight gain and discussed issues. Control group received standard brochure on healthy eating.	120	/	
2.	Jeffries 2009	Women were given a personalised weight measurement card, advised of their optimal gestational weight gain based on their BMI at the time of recruitment and the United States IOM guidelines, and instructed to record their weight at 16, 20, 24, 28, 30, 32 and 34 weeks' gestation.	236	/	/
3.	Laitinen 2009	Dietary counselling was given by a dietitian at each study visit and aimed to modify dietary intake to conform with that currently recommended, particular attention being paid to the quality of dietary fat. Study visits took place 3 times during pregnancy and at 1, 6 and 12 months postpartum.	171	/	
4.	Quinlivan 2011	This was a multi-faceted intervention that included weighing on arrival and a brief dietary intervention by a food technologist at every antenatal visit. Other aspects of the intervention involved continuity of care provider and psychological assessment.	124		/
5.	Rae 2000	The intervention comprised instruction in a moderately energy restricted diabetic diet providing between 1590-1776 kcal (70% RDA).	117		/
6.	Thornton 2009	Participants were counselled in nutrition and monitored by a registered dietitian and given a detailed nutrition program similar to a diabetic diet.	232		/
7.	Wolff 2008	Intervention comprise a healthy diet according to the official Danish dietary recommendations (% fat, protein, CHO, 30%, 15%-20%, 50%-55%). The energy intake was restricted based on individually estimated energy requirements and estimated energetic cost of fetal growth.	50		/
Low GL diet					
8.	Clapp 2002b	Participants were randomised to either a low-glycaemic diet (aboriginal diet) or high-glycaemic diet (cafeteria diet).	20	/	

Table 1. Types of Interventions assessed in studies contributing data (Continued)

9.	Louie 2011	Intervention was a healthy low-GL diet of protein (15%-25%), fat (25%-30%) and carbohydrate (40%-45%) (versus healthy high-fibre diet with moderate GL, similar to population average). Participants attended at least 3 face-to-face visits with the study dietician for monitoring adherence and encouragement. Intervention began after 29th week.	92			/
10.	Moses 2009	Low-GL diet versus high-GL diet. The dietary advice by dietitian was individualised with specific mention of the energy and nutrient balance to achieve normal weight gain during the 3rd trimester.	63			/
11.	Moses 2014	The intervention involved a low glycaemic diet from 12 to 16 weeks' gestation for the remainder of pregnancy (compared with conventional healthy eating). Women received a detailed dietary education tailored for the group assignment at baseline - there were no difference in the macronutrient distribution in the diets, only the substitution of carbohydrate-rich foods with low GL alternatives in the experimental group. Information booklets were provided. 4 contact points with a research dietician were planned (first visit, phone call, midway and final visits) to collect data and ensure adherence.	576			/
12.	Rhodes 2010	Nutrition education, dietary counselling, and a low-GL diet (vs a low-fat diet).	50			/
13.	ROLO 2012	Low-GL dietary intervention given by a dietitian involving 1 dietary education session lasting 2 hours in groups of 2-6 women at baseline. Follow-up reinforcement sessions were held at 28 and 34 weeks' gestation. Women also received written resources about low-GL foods.	759	/	/	/
Diet and exercise counselling						
14.	Althuisen 2013	The intervention involved counselling by members of the research team consisting of 5 x 15 minute sessions on weight, physical activity and diet. Interventions were face-to-face at 18, 22, 30, and 36 weeks' gestation, with a telephone session at 8 weeks postpartum. Counsellors discussed how to control weight gain during and after pregnancy, and how to maintain a healthy lifestyle.	219			/
15	Asbee 2009	At the initial visit, participants met with a registered dietician to receive a standardised counselling session, including in-	100			/

Table 1. Types of Interventions assessed in studies contributing data (Continued)

		formation on pregnancy-specific dietary and lifestyle choices. Participants were instructed to engage in moderate-intensity exercise at least 3 times per week and preferably 5 times per week. Weight gain was reviewed at each routine antenatal visit.		
16.	Asbee 2009	Comprehensive dietary and lifestyle intervention (counselling) (n = 1108) Intervention involved meetings and home visits with advice on dietary, exercise, and behavioural strategies delivered by a dietician and trained research assistants. Exercise advice primarily encouraged women to increase their amount of walking and incidental activity.	2212	/
17.	Ferrara 2011	Lifestyle intervention involved 3 in-person sessions and up to 15 telephone calls with counselling re diet, physical activity and breast-feeding up to 12 months postpartum. The intervention was delivered by 2 dietitians. Participants were encouraged to engage in moderate-intensity physical activity for 150 minutes per week and received written materials about food size, foods with low GL or low fat, and how to read food labels were discussed,	197	/
18.	Guelinckx 2010	2 intervention arms: 1 involved a brochure only, the other involved a brochure and counselling by a trained nutritionist in 3 group sessions. A maximum of 5 women were brought together in these 1-hour sessions, which were scheduled at 15, 20, and 32 weeks of pregnancy. The sessions provided participants with recommendations on a balanced, healthy diet, and physical activity specifically designed for the study to limit weight gain.	124	/
19.	Harrison 2013	Intervention provided dietary advice, simple healthy eating, and "physical activity messages" and weight gain self-monitoring. Also included "regular self-weighing as a key behavioural strategy".	203	/
20.	Hawkins 2014	A lifestyle intervention consisting of a culturally and linguistically modified, motivationally targeted, individually tailored 6-month prenatal programme. Educators encouraged women to achieve guidelines for physical activity, decrease saturated fat and increase dietary fibre. The intervention consisted of 6 monthly in-person behavioural counselling sessions and 5 telephone booster sessions with follow-up to 6 weeks postpartum. Women were encouraged to achieve ≥ 30 minutes of moder-	68	/

Table 1. Types of Interventions assessed in studies contributing data (Continued)

		ate-intensity activity on most days of the week through walking and developing a more active lifestyle.			
21.	Huang 2011	The intervention was delivered at regularly scheduled clinic visits by nurses with training in nutrition and physical fitness. The nurse discussed with each participant how to design an individualised diet and physical activity plan. The intervention consisted of 6 1-to-1 counselling sessions: 1 primary session (about 30–40 minutes) at the 16-week gestation visit, and 5 1-to-1 booster sessions (at 28 gestational weeks, 36–38 gestational weeks, before hospital discharge after a 3 to 7-day stay, 6 weeks' postpartum and 3 months postpartum). After each clinic visit, women in the experimental groups were sent a personalised graph of their weight changes. At the 1st session, the experimental groups also received a researcher-prepared brochure that provided detailed information on weight management goals during pregnancy and postpartum.	160	/	
22.	Korpi-Hyovalti 2011	Individual dietary advice tailored to each participant at 6 visits to include a low fat diet rich in vegetables, fruit and berries. Moderate-intensity physical exercise was encouraged at 6 exercise counselling sessions.	60		/
23.	Luoto 2011	Individual counselling on physical activity and diet and weight gain. At the first visit the recommendations for gestational weight gain were discussed and an appropriate weight gain graph was selected to guide the participant in monitoring her weight gain. Physical activity counselling was implemented at 8–12 weeks' gestation and the dietary counselling session occurred at 16–18 weeks' gestation. Physical activity counselling was enhanced at 4, and diet counselling at 3 subsequent visits.	399		/
24.	Petrella 2013	Lifestyle intervention involving a caloric restricted diet (1500 kcal/day) and mild exercise 30 minutes/day, 3 times per week monitored by a pedometer.	63		/
25.	Phelan 2011	The Fit for Delivery intervention included a face-to-face visit with an interventionist at the onset of treatment who discussed appropriate weight gains during pregnancy, physical activity (30 minutes of walking most days of the week), and calorie goals (20 kcal/kg). Emphasis was placed on decreasing high fat foods, increasing physical activity, and daily self-monitoring. Women	401	/	/

Table 1. Types of Interventions assessed in studies contributing data (Continued)

		also received personalised weight graphs after each clinic visit, automated supportive postcards and 3 supportive phone calls.			
26.	Polley 2002	Intervention conducted at routine clinic visits by staff with training in nutrition or psychology involved education about weight gain, healthy eating, and exercise, and individual graphs of their weight gain. After each clinic visit, women were sent a personalised graph of their weight gain.	110	/	/
27.	Poston 2013	A lifestyle intervention (diet plus exercise) involving 1 1-to-1 counselling session with a health trainer and then weekly group sessions for 8 consecutive weeks from 19 weeks' gestation. Sessions delivered by health trainers involved diet and exercise advice informed by psychological models of health behaviour. Dietary advice focused on increased consumption of foods with a low-dietary GL, and reduction of saturated fats. Physical activity advice encouraged women to increase daily walking activity at moderate-intensity level, setting goals monitored by a pedometer. Women also received a DVD of a pregnancy specific exercise regimen.	154		/
28.	Renault 2014	A 3-arm study with 2 intervention groups. 1 intervention involved unsupervised exercise only (women were given a pedometer), the other involved diet and exercise counselling only. The diet and exercise intervention included follow-up on a hypocaloric Mediterranean-style diet. Instruction was given by a dietician every 2 weeks with alternating outpatient visits and phone calls, including weight measurement, encouragement and correcting advice on exercise and diet.	389		/
29.	Vesco 2013	Intervention involved a 45-minute diet consultation with an individualised caloric goal, a second individualised session, weekly group meetings with weigh ins, food/activity logs. Women are encouraged to accumulate at least 30 minutes of moderate-intensity activity per day. Pedometers recorded steps with a target of 10,000 steps daily and were only provided to the intervention group.	114		/
Unsupervised exercise intervention					
30.	Kong 2014	Unsupervised exercise intervention involved a walking program on treadmill or other setting for a minimum of 150 min/	42		/

Table 1. Types of Interventions assessed in studies contributing data (Continued)

		week. Women were loaned treadmills for the study and steps monitored.				
31.	Renault 2014	A 3-arm study with 2 intervention groups. 1 intervention involved unsupervised exercise only (women were given a pedometer), the other involved diet and exercise counselling. The physical activity intervention included encouragement or increase physical activity, aiming at a daily step count of 11,000, monitored by pedometer assessment on 7 consecutive days, every 4 weeks.	389			/
32.	Ronnberg 2014	Intervention involved prescribed exercise to be at a "moderate level of exertion for approximately 30 min/day".	374	/	/	/
Supervised exercise intervention						
33.	Barakat 2011	Intervention involved 35- to 45-minute exercise sessions 3 times per week from the start of the pregnancy (weeks 6-9) to the end of the 3rd trimester (weeks 38-39) - an average of 85 training sessions. Exercise intensity was light-to-moderate and was supervised by a fitness specialist in groups of 10-12 women.	80			/
34.	Cordero 2014	A supervised exercise program consisting of aerobic and toning exercises for 3 sessions per week. 2 weekly sessions were performed on land (60 minutes) and 1 session was aquatic based (50 minutes). Program commenced from 10-14 weeks to the end of the third trimester. Sessions were supervised by a qualified fitness specialist and an obstetrician.	257			/
35.	De Oliveria Melo 2012	Supervised moderate-intensity exercise (initiated at 13 weeks or 20 weeks) vs control. Sessions consisted of warming up and stretching exercises, followed by supervised walking 3 times a week in the open air. Supervised by physical education professionals and medical, physiotherapy and nursing students.	187			/
36.	Haakstad 2011	Exercise (60 minutes supervised aerobic dance at least twice a week for a minimum of 12 weeks) (n = 52). Women in the exercise group were advised to have moderate, self-imposed physical activity on the remaining weekdays.	105			/
37.	Murtezani 2014	The exercise training program started in the second trimester and was continued until the end of pregnancy. Each session consisted of 40-45 minutes of aerobic and strength exercise. Individuals were super-	63			/

Table 1. Types of Interventions assessed in studies contributing data (Continued)

		vised by certified aerobic-instructors, and each session included a maximum of 10 participants. Intensity was moderate-to-vigorous; supine postures and Valsalva manoeuvres were avoided.				
38.	Nascimento 2012	Intervention consisted of a supervised exercise program guided by a trained physical therapist in weekly classes with light-to-moderate-intensity exercise for 40 minutes. It also included home exercise counselling which was to be performed 5 times per week (consisting of a sequence of 22 exercises or walking).	82			/
39.	Oostdam 2012	A supervised exercise intervention comprising 2 sessions of aerobic and strengthening exercises per week; each exercise session lasted for 60 minutes from 20 weeks' gestation.	101			/
40.	Petrov Fieril 2014	Intervention group received supervised resistance exercise twice a week, with light barbells and weight plates in a group setting, performed at an activity level equivalent to within moderate-to-vigorous between weeks 14 to 25 gestation, and was self-adjusted. In addition, walking, cycling, water-gymnastics, Pilates, yoga and home exercises that included pelvic floor training were recommended.	72			/
41.	Price 2012	Intervention involved a program of supervised aerobic training of 45-60 minutes, 4 days per week.	62			/
42.	Ruiz 2013	Intervention involved light-to moderate-intensity supervised aerobic and resistance exercises (including pelvic floor exercises) performed 3 days a week (50-55 minutes per session) from 9 weeks to weeks 38-39. Exercise sessions involved 8-10 participants.	962	/	/	/
43.	Santos 2005	The intervention consisted of a program of supervised physical exercise of 60 minutes duration, performed 3 times per week for 12 weeks.	72			/
44.	Stafne 2012	intervention comprised a 12-week regular standardised exercise program including aerobic activity, strength training, and balance exercises. The exercise program followed standard recommendations and included moderate-intensity to high-intensity activity 3 or more days per week. Physiotherapist-supervised training sessions of 60 minutes in groups of 8-15 women were offered once per week.	702			/

Table 1. Types of Interventions assessed in studies contributing data (Continued)

Supervised exercise and diet intervention

45.	Hui 2006	Exercise intervention involved a weekly supervised group session including floor aerobics, stretching and strength exercises, and similar home-based exercise 3-5 times/week for 30-45 minutes per session. A video was provided to participants to assist with home-based exercise. Diet intervention involved a computer-assisted food choice map interview and a personalised plan by a dietician.	46	/	
46.	Hui 2012	Exercise intervention involved an exercise regimen comprising 3 to 5 times per week, including a weekly supervised community-based session and multiple home sessions, of mild-to-moderate exercise for 30 to 45 minutes. Program started between 20-26 weeks. Group exercise sessions including aerobics were held in community centres and instructors were licensed fitness trainers. 2 dietary interviews with counselling were provided.	190	/	
47.	Hui 2014	Lifestyle intervention (diet counselling and a supervised exercise program) vs control. Intervention included "a community-based exercise program specifically designed for pregnant women was provided". An exercise regimen, 3 to 5 times per week including a weekly exercise session and home sessions with DVD instruction of mild-to-moderate aerobic exercise for 30 to 45 minutes was recommended. Program started between 20-26 weeks and continued to 36 weeks. Group exercise sessions including aerobics were held in community centres and instructors were licensed fitness trainers. 2 dietary interviews with dietician counselling using a Food Choice Map were provided (baseline and 2 months later). Control group received standard care.	113	/	/
48.	Ruchat 2012	Moderate-intensity exercise 3-4 times per week, including 1 supervised session (versus low-intensity exercise in the form of a walking program 3-4 times per week). All participants received a diet plan based on a modified diabetic diet.	49	/	
49.	Vinter 2012	A lifestyle intervention consisting of dietary counselling and exercise. The intervention involved dietary advice on 4 occasions (15, 20, 28 and 35 weeks) by a dietician. Energy requirements were personalised for each participant. Exercise intervention included a pedometer and free gym membership for 6 months. Participants were encouraged to	304		/

Table 1. Types of Interventions assessed in studies contributing data *(Continued)*

do 30-60 minutes moderate-physical activity daily. In addition, at the gym they had 1 supervised aerobic class with a physiotherapist for 1 hour each week.

BMI: body mass index

CHO: carbohydrate

GL: glycaemic load

IOM: Institute of Medicine

RDA: recommended dietary allowance

APPENDICES

Appendix 1. Adjusted data for Luoto 2011

Continuous outcome	Intervention (Original data) (Total number = 216)		Control (Original data) (Total number = 179)		M ¹	ICC ²	Design effect ³	Adjusted sample ⁴ sizes	
	Cluster number	$\bar{x} \pm SD$	Cluster number	$\bar{x} \pm SD$				Intervention	Control
Maternal weight gain	7	13.8±5.8	7	14.2±5.1	28.21	0.12	4.27	50.64	41.96

1 $M = \text{average cluster size} = ((\text{total number of intervention} + \text{total number of control}) / (\text{cluster number of intervention} + \text{cluster number of control}))$

2 ICC = intraclass correlation; obtained from the reliable external source (Luoto 2010).

3 Design effect = $1 + (M-1)ICC$

4 Adjusted sample sizes = $n / \text{design effect}$

Dichotomous outcomes	Intervention	Control	M ¹	ICC ²	Design effect ³	Intervention		Control	
	(Original data) (Total number = 216, cluster number = 7)	(Original data) (Total number = 179, cluster number = 7)				(Adjusted data) ⁴	(Adjusted data) ⁴	Total N	n
Pre-eclampsia	14	10	28.21	0.12	4.27	50.64	3.28	41.96	2.34
Birthweight > 4000 g	37	36	28.21	0.12	4.27	50.64	8.67	41.96	8.44
Infant birthweight > 90th centile	26	34	28.21	0.12	4.27	50.64	6.10	41.96	7.97
Infant birthweight < the 10th centile	10	5	28.21	0.12	4.27	50.64	2.34	41.96	1.17

Appendix 2. Data for Rauh 2013

Continuous outcomes	Intervention		Control		Adjusted P value
	$\bar{x} \pm SD$	Total number	$\bar{x} \pm SD$	Total number	
Weight gain	14.1 ± 4.1	152	15.6 ± 5.8	74	0.035
Weight retention (at 4 months postpartum)	2.1 ± 4.3	152	3.3 ± 5.1	72	0.070
Infant birthweight	3406 ± 402	156	3414 ± 445	79	-

Dichotomous outcomes	Intervention		Control		Adjusted P value
	Number	Total number	Number	Total number	
Excessive weight gain	58	152	44	74	0.032
Low weight gain	32	152	14	74	0.972
Weight retention (> 5 kg)	26	152	22	72	0.034
Preterm	4	156	5	79	0.088
Caesarean delivery	47	156	33	79	0.145
Gestational diabetes	8	156	9	79	0.183
Infant birthweight > 90th centile	10	156	7	79	0.702
Infant birthweight < 10th centile	6	156	3	79	0.990
Induction of labour	40	156	29	79	0.191

WHAT'S NEW

Date	Event	Description
12 June 2015	Amended	Minor correction to acknowledgements.

HISTORY

Protocol first published: Issue 2, 2008

Review first published: Issue 4, 2012

Date	Event	Description
23 April 2015	New citation required and conclusions have changed	High-quality evidence suggests that diet or exercise, or both, interventions are effective in reducing excessive gestational weight gain. Hypertension, caesarean delivery, macrosomia and neonatal respiratory distress may also be reduced, particularly with combined diet and exercise interventions. Exercise appears to be an important part of controlling weight gain in pregnancy and more research is needed to establish safe guidelines.
5 November 2014	New search has been performed	<p>Search updated and 169 new records identified. There are now 65 (previously 28) included studies, 49 (previously 27) of which contribute data.</p> <p>The title has been changed from 'Interventions for preventing excessive weight gain during pregnancy' to '<i>Diet or exercise, or both, for preventing excessive weight gain during pregnancy</i>'. This was done to limit the otherwise enormous scope of the review. As a result of the title modification, two previously included 1970s studies of (obsolete) appetite suppressant drug interventions were excluded in this update. Drug interventions (e.g. metformin, probiotics), will now need to be addressed under a separate title.</p> <p>Methods updated and GRADE 'Summary of findings' tables have been incorporated.</p>
10 November 2008	Amended	The <i>Types of interventions</i> section was amended by the inclusion of the phrase 'or other interventions for preventing excessive weight gain in pregnancy'. This amendment was made to ensure that the selection criteria are consistent with the objectives of the review which are to evaluate the effectiveness of all interventions (or combinations of interventions) to prevent excessive weight gain.

CONTRIBUTIONS OF AUTHORS

B Muktabhant (BM) conceived and designed the draft protocol. P Lumbiganon (PL) and C Ngamjarus (CN) reviewed and commented on the revisions of the protocol. For the original review, BM, CN and T Dowswell (TD) selected studies, extracted data and conducted data analysis. BM and TD drafted the original review with feedback from PL and CN. For the update, BM and T Lawrie (TL) selected studies, extracted data, conducted data analysis and prepared the review. ML and PL contributed to data analysis, discussion and revision of the manuscript. All authors approved the final version of the review.

DECLARATIONS OF INTEREST

None known.

SOURCES OF SUPPORT

Internal sources

- Khon Kaen University, Thailand.
- University of Liverpool, UK.

External sources

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DIFFERENCES BETWEEN PROTOCOL AND REVIEW

This update differs from the protocol and previous versions of the review in the following ways.

1. The title has been changed from 'Interventions for preventing excessive weight gain during pregnancy' to '*Diet or exercise, or both, for preventing excessive weight gain during pregnancy*'. This was done to limit the otherwise enormous scope of the review. As a result of the title modification, two previously included 1970s studies of (obsolete) appetite suppressant drug interventions were excluded in this update. Drug interventions (e.g. metformin, probiotics), will now need to be addressed under a separate title.
2. The protocol and previous versions of this review included quasi-RCTs. For this update, we have excluded quasi-RCTs. We believe that the large and growing number of RCTs in this field justifies our approach of only using the best quality trials (RCTs).
3. We amended the [Subgroup analysis and investigation of heterogeneity](#) section of the methods by including subgroup analysis according to the risk of excess weight-related adverse outcomes (low-risk, mixed-risk and high-risk populations).
4. For this update, we decided to include the additional outcomes 'birthweight' and 'hypertension'; these are frequently reported outcomes in the context of the review interventions. Although they were not prespecified, the decision to include these outcomes was taken before commencing data extraction. We re-visited previously included studies to retrieve these data, where reported. By capturing these additional data we hope that this and future versions of the review will be more complete.
5. We amended the outcome 'complications relating to macrosomia' to include 'neonatal respiratory distress syndrome'.

INDEX TERMS

Medical Subject Headings (MeSH)

*Diet; *Exercise; *Weight Gain; Counseling; Overweight [complications] [*prevention & control]; Pregnancy Complications [*prevention & control]; Randomized Controlled Trials as Topic

MeSH check words

Female; Humans; Infant, Newborn; Pregnancy