Acta Obstetricia et Gynecologica. 2008; 87: 702–706

informa
healthcare

ACTA REVIEW

Dietary and lifestyle interventions to limit weight gain during pregnancy for obese or overweight women: A systematic review

JODIE M. DODD, CAROLINE A. CROWTHER & JEFFREY S. ROBINSON

The Discipline of Obstetrics and Gynaecology, The University of Adelaide, Adelaide, Australia

Abstract

Background. To assess the benefits and harm of dietary and lifestyle interventions during pregnancy to improve maternal and infant outcomes for pregnant women who are overweight or obese. *Methods*. Randomized controlled trials comparing any form of dietary or lifestyle intervention during pregnancy for women who are overweight or obese with no treatment to improve maternal and infant health were considered. The Cochrane Controlled Trials Register (CENTRAL), PUBMED and the Australian and International Clinical Trials Registry were searched (date of last search November 2007). *Results*. Two published trials were identified with no statistically significant differences identified between the intervention and standard care groups for maternal or infant health outcomes. *Conclusion*. There is limited information available assessing the benefits and harm associated with dietary and lifestyle interventions for overweight and obese pregnant women. Further evaluation through randomized trials with adequate power is required.

Key words: *Dietary and lifestyle interventions, obesity, pregnancy outcomes, systematic review, randomized controlled trial*

Background

The World Health Organisation has described obesity as one of the most obvious yet neglected global health problem (1). Obesity is considered the sixth most important factor contributing overall to the worldwide burden of disease (2), and is a well-recognized risk factor reducing life expectancy through the increased occurrence of cardiovascular disease, type 2 diabetes, and several cancers (2).

Current literature suggests that 35% of women aged between 25 and 35 years are overweight or obese (3), with 34% of pregnant women having a body mass index (BMI) above 25 kg/m^2 (4). Obesity during pregnancy is associated with well documented risks, including hypertensive conditions and pre-eclampsia (4–10), gestational diabetes (4–6,8,10), infection (5), and thromboembolic events (5). Complications during labor and birth are also increased, with overweight or obese women more likely to require induction of labor (5,10), and cesarean section (4–10). Up to one in seven cesarean births have been attributable to maternal obesity (8), the risk increasing by 7% for every one unit increase in maternal BMI (11). Women who are overweight or obese are more likely to have a stillbirth or perinatal death (4,9–15), and live-born infants are at increased risk of macrosomia (6,7,11,12), need for admission to the neonatal intensive care unit (4,11,12), preterm birth (4,11,12), congenital anomaly (4,11,12), and need for treatment of jaundice or hypoglycemia (4).

The risks of adverse maternal and infant health outcomes increase as BMI increases (4). Suggestions have been made that overweight or obese women who gain <8 kg in weight during pregnancy have lower rates of large-for-gestational age babies, pre-eclampsia, cesarean section and operative vaginal birth compared to overweight and obese women who have higher weight gain during pregnancy (14); the authors concluding that obese women may benefit from a limited weight gain in pregnancy, as has been previously recommended by the Institute of Medicine (16). While there is an extensive literature

Correspondence: Jodie M. Dodd, Discipline of Obstetrics and Gynaecology, The University of Adelaide, The Women's & Children's Hospital, 72 King William Road, North Adelaide, South Australia, Australia 5006. E-mail: jodie.dodd@adelaide.edu.au

(Received 11 December 2007; accepted 14 March 2008)

ISSN 0001-6349 print/ISSN 1600-0412 online
DOI: 10.1080/00016340802061111

defining the problems and complications associated with obesity during pregnancy and childbirth, there is limited information available related to effective interventions that can be implemented to improve maternal, fetal and infant health outcomes.

Our objectives were to conduct a systematic review to identify the risks and benefits of dietary and lifestyle interventions (alone or in combination), to limit weight gain in overweight and obese women during pregnancy, and to improve maternal, fetal and infant health outcomes.

Materials and methods

We conducted a systematic review of the literature in which randomized controlled trials with data reporting outcomes for pregnant women and their infants, who were overweight or obese (as defined by the trial authors), who received dietary and lifestyle interventions (alone or in combination) during pregnancy to limit weight gain, with the intention of improving maternal, fetal and infant health outcomes who were compared women who did not receive these interventions were considered. As this was a systematic review of the literature, ethics committee approval was not required.

The primary outcome measure for the review was the occurrence of large-for-gestational-age infants (defined as birth weight above the 90th centile for sex and gestational age). Other maternal and infant health outcomes are detailed in Table I.

We searched the Cochrane Controlled Trials Register (CENTRAL), PUBMED, and the Australian (ACTR) and International (ICTN) Clinical Trials Registry, using the free-text terms: overweight, obesity, body mass index, dietary intervention, lifestyle intervention, pregnancy and randomized controlled trial. Date of the last search was November 2007.

Studies under consideration were evaluated independently for appropriateness for inclusion and methodological quality without consideration of their results by two authors (JMD and CAC), according to QUORUM guidelines for systematic reviews of randomized trials (18). There was no blinding of authorship. Assessment of quality considered generation of the randomization sequence, allocation concealment, blinding, and completeness of follow-up. Data were extracted independently by two authors (JMD and CAC), and entered into the RevMan statistical programme. For dichotomous data, relative risks (RR) and 95% confidence intervals (CI) were calculated, with primary analyses based on intention-to-treat principles. Sensitivity analyses were planned to evaluate the effect of trial quality, and planned subgroup analyses included an assessment of body mass index category and the nature of different interventions.

Table I. Secondary outcomes of the review.

Maternal outcomes
Hypertension
Pre-eclampsia or eclampsia
Gestational diabetes
Need for and length of antenatal hospital stay
Antepartum hemorrhage requiring hospitalization
Preterm prelabor ruptured membranes (PPROM)
Prelabor ruptured membranes at term
Chorioamnionitis
Need for induction of labor
Cesarean section
Instrumental vaginal birth
Postpartum hemorrhage requiring blood transfusion
Perineal trauma
Wound infection
Endometritis
Infant outcomes
Preterm birth <37 weeks' gestation
Congenital anomalies
Infant birth weight $>4{,}000$ g
Infant birth weight $<2{,}500$ g
Apgar score <7 at 5 min
Hypoglycemia requiring intravenous treatment
Admission to neonatal intensive care unit. Hyperbilirubinemia requiring phototherapy
Birth trauma (nerve palsy, fracture, or shoulder dystocia). Birth asphyxia (neonatal irritability, neonatal seizures, neonatal hypotonia, abnormal level of consciousness, neonatal apnea, tube feeding >48 h)

Our search strategy identified two published randomized controlled trials (19,20). The randomized trial by Polley (19) recruited women at <20 weeks' gestation from an obstetric clinic for low income women in Pittsburgh, USA, with the intention of providing an intervention to reduce the proportion of women whose weight gain in pregnancy was above the IOM recommendations (16). Women were stratified at the time of trial entry according to BMI category (BMI ≤ 26 who were considered of normal BMI, and BMI >26), with results presented by BMI category. A total of 49 women who were overweight were randomized to standard care (22 women), or to receive a stepped care behavioral intervention (27 women), consisting of education and feedback relating to optimal weight gain, exercise in pregnancy, and healthy eating (concentrating on a low fat dietary intake). Women who gained more weight than recommended received additional individual counseling sessions, focusing on increasing exercise levels, specific behavioral techniques, and structured goal setting to improve dietary intake. The primary outcomes reported related to the proportion of women who

exceeded the IOM recommendations for weight gain during pregnancy.

Rae et al. (20) recruited 125 women with a BMI >110% of ideal (BMI of 25 considered ideal), with a diagnosis of gestational diabetes, prior to 36 weeks' gestation. Women were randomized to either the standard diabetic dietary information or to a dietary intervention restricting energy intake to 70% of recommended daily intake (1,776 kCal) (20). The primary outcomes reported related to the need for maternal insulin therapy, and infant macrosomia (defined as birth weight above the 90th centile for gestational age or >4,000 g).

The quality of the trials was poor. The trial by Polley et al. (19) did not provide information relating to the method of generating the randomization sequence, the process of allocation concealment, and whether outcome assessors were blinded to the intervention. The trial by Rae (20) did not indicate the method of generating the randomization sequence, but had adequate allocation concealment using sealed opaque envelopes. There was no indication of blinding of outcome assessors. See Table II for more details of the included studies.

Results

Due to the considerable variation in the interventions offered, including the duration and gestational age at commencement, it was not considered appropriate to combine the results in a meta-analysis.

For the pre-specified clinical outcomes reported by Polley (19), there were no statistically significant differences identified between the two groups for infant birth weight >4,000 g (one study; 49 women; RR not estimable), infant birth weight <2,500 g (one study; 49 women; RR 0.41; 95% CI 0.04, 4.20), preterm birth (one study; 49 women; RR 0.54; 95% CI 0.10, 2.97), cesarean section (one study; 49 women; RR 0.27; 95% CI 0.06, 1.21), pre-eclampsia (one study; 49 women; RR 0.54; 95% CI 0.10, 2.97), hypertension (one study; 49 women; RR 0.81; 95% CI 0.23, 2.89) or gestational diabetes (one study; 49 women; RR 1.63; 95% CI 0.16, 16.81).

For the pre-specified clinical outcomes reported by Rae (20) there were no statistically significant differences identified between the two groups for maternal hypertension (one study; 125 women; RR 0.58; 95% CI 0.30, 1.09); pre-eclampsia (one study; 125 women; RR 0.93; 95% CI 0.48, 1.82); need for induction of labor (one study; 125 women; RR 1.09; 95% CI 0.72, 1.66); instrumental vaginal birth (one study; 125 women; RR 0.99; 95% CI 0.38, 2.56); or cesarean birth (one study; 125 women; RR 1.18; 95% CI 0.74, 1.91). There were seven sets of twins born, but as they were not reported according to allocated treatment group, it was not possible to calculate the RRs for the outcome shoulder dystocia (three infants in the control group). The occurrence of infant birth weight >4,000 g was reported as percentages only, and therefore could not be used to calculate a RR.

Discussion

The results of our systematic review indicate that there is currently limited information available on which to base clinical recommendations about effective dietary and lifestyle interventions for pregnant women who are overweight or obese. While there is an extensive body of literature related to defining the problems and potential complications associated with obesity during pregnancy and childbirth, there is limited information available related to effective interventions that may be implemented to improve maternal, fetal and infant health outcomes. The current combined sample size of 174 women from randomized controlled trials to date is significantly underpowered to identify clinically important differences in relevant maternal, fetal, and infant health outcomes.

Table II. Characteristics of included studies.

Author	Methods	Participants	Intervention	Outcomes
Polley (19)	Randomization: not stated. Allocation concealment: not stated. Blinding: not stated.	49 women with BMI >26 at <20 weeks' gestation. Exclusion: <18 years age, first visit >12 weeks, multiple pregnancy, 'high-risk' pregnancy.	Stepped care behavioral intervention (education, feedback relating to weight gain, exercise and healthy eating) versus standard care.	Primary outcome: proportion of women whose weight gain exceeds IOM recommendations.
Rae (20)	Randomization: not stated. Allocation concealment: sealed opaque envelopes. Blinding: not stated.	125 obese women with a diagnosis of gestational diabetes. Exclusion: gestational age >36 weeks.	Diet with energy restriction (70% of recommended daily intake) versus standard diabetic diet.	Primary outcome: need for maternal insulin therapy; infant macrosomia (birth weight >4,000 g or >90th centile).

Current guidelines recommend that, ideally, women should be counseled prior to conception about the increased pregnancy risks associated with obesity, and encouraged to make lifestyle changes to minimize their risk of developing subsequent complications (17), with calls for well-designed studies to evaluate dietary and lifestyle interventions during pregnancy for overweight and obese women (14,21).

Unanswered questions

The effect of dietary restriction and exercise on infant birth weight. Average maternal weight gain during pregnancy has been estimated between 10 and 15 kg, with the rate of gain in the last half of pregnancy ranging from 0.45 to 0.52 kg per week, although this is often more excessive for women who are obese (16). While implementation of recommendations to limit maternal weight gain during pregnancy has been shown in non-randomized studies to reduce the risk of birth of a large-for-gestational-age infant (22), concern has been expressed about too severe a restriction of diet. Thus, current recommendations have been made to avoid weight loss during pregnancy and to limit restriction of weight gain to approximately 5 kg throughout pregnancy (20). While restriction of weight gain in pregnancy has been associated with an increase in the incidence of preterm birth in women with a normal BMI, this has not been demonstrated in women with a BMI >26 kg/m^2 (23). The Cochrane systematic review evaluating energy and protein restriction in pregnancy, identified a risk of impaired fetal growth associated with energy and protein restriction (24), although an increase in small-for-gestational-age babies has not been borne out in later studies, including the recent randomized trial ACHOIS (5), in which for women treated with dietary and exercise advice, there was a significant reduction in the incidence of macrosomia without any increase in the incidence of small-for-gestational-age infants.

Exercise in pregnancy affects health outcomes for the woman through improved cardiovascular function and restriction of weight gain (25), with a documented reduction in the risk of preterm birth (26), and favorable affects on labor and birth (25). Benefits for the infant include reduced fat mass at birth, which extends into childhood (25). However, the benefits of introduction of exercise in pregnancy for previously sedentary women remain to be established (27). The Cochrane systematic review assessing the role of exercise for diabetic pregnant women identified four randomized trials involving 114 women with gestational diabetes in the third trimester of pregnancy (28). While this review failed to identify a beneficial effect of exercise, the combined sample size is inadequately powered to identify differences in clinically important maternal and infant health outcomes, and evaluated a short intervention in late pregnancy.

The ongoing health effects of antenatal dietary and lifestyle interventions on infant and child health, particularly in relation to the development of childhood obesity, remain uncertain. Therefore, ongoing follow-up of participants in randomized controlled trials is essential.

The nature of dietary and lifestyle interventions. There are three Cochrane systematic reviews of relevance assessing the role of dietary advice for weight loss in adults with 'prediabetes' (29), for treatment of type 2 diabetes (30), and psychological interventions for overweight or obese adults (31). In these reviews, interventions assessed included the provision of dietary material and recommendations for weight loss, specific approaches to increasing activity levels (including counseling, exercise prescription and participation in both supervised and unsupervised exercise programmes), and behavioral interventions including education, cognitive-behavioral therapy, social support and psychotherapy to address barriers to diet or physical therapy (29–31). The results of these systematic reviews indicate a significant benefit in terms of weight loss and improvement in health outcomes when a multifaceted intervention is adopted, compared with stand-alone dietary advice, exercise modification or behavioral strategies (29–31). Importantly, the number of contacts for the intervention correlated significantly with the degree of weight loss (29). The format and intensity of any intervention offered to women during pregnancy to limit weight gain remains uncertain.

Obesity is a significant health issue for women during pregnancy and childbirth, with estimates suggesting that 35% of women aged between 25 and 35 years are overweight or obese. There are well-documented risks associated with obesity during pregnancy and childbirth. There is currently limited information available from randomized controlled trials to assess the benefits and harm of antenatal dietary and lifestyle interventions to limit weight gain during pregnancy for overweight and obese women, on maternal, fetal and infant health outcomes. Evaluation of the role of these interventions in reducing the burden of a major cause of maternal, infant and childhood morbidity related to obesity is warranted.

Acknowledgements

Australian National Health and Medical Research Council Neil Hamilton Fairley Overseas Clinical Fellowship (ID 399224) (to JMD).

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