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An overview of evidence on diet and physical activity based interventions for gestational weight management

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A table, which provides an overview of the findings and recommendations from all 12 identified reviews covered in this paper, is available online and can be accessed at: rcm.org.uk/ebm

Abstract

Background. Maternal obesity and excessive gestational weight gain are associated with adverse maternal and neonatal outcomes. Currently, 20% of mothers in the UK are obese and the prevalence of obesity is increasing. In the UK, there is a lack of evidence or guidelines quantifying an ideal gestational weight gain or strategies to encourage women to remain within these limits.

Aim. To provide an overview of systematic evidence which have synthesised the results from trials on the efficacy of gestational weight management interventions, and to discuss key components of effective diet or physical activity interventions in improving pregnancy and birth outcomes.

Method. English language systematic reviews published after the NICE guidance on weight management before, during and after pregnancy (2010) were searched for using Medline.

Findings. A total of 12 systematic reviews were identified. Most reported interventions had an effect on reducing weight gain, however, included studies were often of poor quality.

Conclusion. Dietary interventions seem to be more effective in reducing gestational weight gain with some improvement in clinical outcomes (for example, reducing the risk of gestational diabetes, gestational hypertension and shoulder dystocia). Physical activity also has a role to play, however, in light of low compliance and concerns over limited understanding of its full impact on fetal growth and birthweight, more robust investigations are required to address the balance between its benefits, acceptability and impact on birthweight.

Implications. Further research is required to identify optimum gestational weight gain and the particular components of interventions that have been shown to be effective and safe in reducing this during pregnancy. Midwives, with their key role in health promotion, should be offered support and training in keeping up to date with the growing body of evidence on gestational weight management and behaviour change techniques to promote a healthy lifestyle for women and their families.

Key words: Gestational weight management, diet, effectiveness, behaviour change, physical activity, pregnancy, evidence-based midwifery

Introduction

Management of a healthy weight in modern society is notoriously difficult to achieve and sustain. Current evidence suggests that 20% of mothers in the UK are obese and the prevalence of obesity in our society is increasing (Heselhurst et al, 2010). Maternal obesity and excessive gestational weight gain are associated with adverse maternal and neonatal outcomes, including early miscarriage, macrosomia, gestational diabetes mellitus, postpartum haemorrhage and traumatic birth (Olson and Blackwell, 2011). These are in addition to an increased risk of obesity, type 2 diabetes mellitus and heart disease in later life for offspring born to obese mothers (Olson, 2012), thus having consequences for the health and wellbeing of future generations.

Given the costs of obesity, to the individual, future generations and wider society, it is prudent to address the issue of obesity within a childbearing population.

In the UK, there is a lack of evidence or guidelines quantifying a clear gestational weight gain or strategies to encourage women to remain within these limits. NICE (2014,

2010) highlights the importance of limiting gestational weight gain by healthy eating and physical activity (PA), but fails to state any recommended weight gain limits. The American Institute of Medicine recommends weight gains for different pre-pregnancy BMI categories, including 5kg to 9kg for obese women, although their review of the evidence failed to find statistically powerful studies to support these guidelines (Rasmussen and Yaktine, 2009).

Pregnant women and their health professionals need guidelines to benchmark their weight gains against, and to be able to intervene if necessary. But until appropriate evidence is generated to support development of such guidelines, current practice aims to reduce gestational weight gain in obese women, as there are clear risks associated with excessive weight gain during pregnancy (Scott-Pillai et al, 2013; Olson and Blackwell, 2011).

Aim

This study aimed to provide an overview of systematic evidence which synthesised the results from trials on the efficacy of gestational weight management interventions. It

also aims to discuss key components of effective diet or PA interventions in improving pregnancy and birth outcomes. The participants' acceptability of diet and PA interventions and the feasibility of delivering such interventions within the UK will also be considered as important factors in designing future interventions.

Method

Search strategy

The Medline database was searched to identify any systematic reviews that have reported on gestational weight management since 2010. The search was limited to English language where gestational weight gain was stated as a primary or secondary outcome. Search terms included: 'weight gain', 'weight management', 'pregnancy', 'antenatal', 'gestation', 'intervention', 'systematic review', 'exercise', 'diet', 'physical activity', 'lifestyle and behaviour change'.

Findings

A total of 12 systematic reviews were identified and included (Currie et al, 2013; Furber et al, 2013; Brown et al, 2012; Muktabhant et al, 2012; Oteng-Ntim et al, 2012; Thangaratinam et al, 2012; Campbell et al, 2011; Gardner et al, 2011; Quinlivan et al, 2011a; Tanentsapf et al, 2011; Dodd et al, 2010; Ronnberg and Nilsson, 2010), which synthesised the results from trials on the efficacy of interventions designed to improve weight outcomes for mothers.

Study characteristics

Reviews such as Furber et al (2013), Oteng-Ntim et al (2012), Quinlivan et al (2011a) and Dodd et al (2010) focused on interventions specifically aimed at overweight and/or obese pregnant women. While some reported weight gain as a secondary outcome, Brown et al (2012), Muktabhant et al (2012), Gardner et al (2011) and Tanentsapf et al (2011) analysed studies which explicitly stated the primary objective of preventing excessive weight gain during pregnancy. Campbell (2011) included five randomised controlled trials (RCTs), looked at eight qualitative studies and concluded that there were some barriers to behaviour change raised by women, but not met by the interventions, which may limit effectiveness.

The reviews by Currie et al (2013), Brown, et al (2012) and Gardner et al (2011) looked specifically at the behavioural components of interventions, such as goal setting, which appears successful for managing gestational weight gain.

The review by Thangaratinam et al (2012), commissioned by the Health Technology Assessment, consisted of a meta-analysis of 44 RCTs, which included dietary, PA and mixed interventions (with both diet and activity, or other approaches, such as weight monitoring), many of which have also been included in the above mentioned reviews. Dietary interventions generally included a balanced diet of carbohydrates, proteins and fat and use of a food diary. They reported a significant reduction in gestational weight gain of 1.42kg when all interventions were analysed together, compared to the control group. Dietary interventions were, however, more effective in reducing gestational weight

gain, compared to the PA or mixed approaches (3.8kg vs 0.7kg vs 1.0kg, respectively). Dietary interventions were also associated with more improvements in the obstetric outcomes (for example, reducing the risk of gestational diabetes, gestational hypertension and shoulder dystocia). There was no significant effect on neonatal birthweight with any of the interventions, except for PA. Reduction in gestational weight gain remained significant with all interventions and the risk of pre-eclampsia was consistently lower with dietary interventions, in the sub-group analyses based on diabetic status, BMI and bias risk status.

Thangaratinam et al (2012) concluded that dietary interventions were most effective, while others such as Oteng-Ntim et al (2012) and Ronnberg and Nilsson (2010) expressed caution in advocating any particular approach to weight management in pregnancy, highlighting the poor quality of many of the studies included in their review, the significant demographic heterogeneity of participants in the different studies and the highly variable degree of intervention intensity. They concluded the need for further well-designed, suitably powered research before any recommendations can be made. Gardner et al (2011) expressed similar concerns, while also addressing issues of reporting in the literature, and the impact of omissions in reporting on future intervention development.

Summary results

Most of the 44 studies included in Thangaratinam's review had also been included in the other reviews (which contained between 0 and 28 studies) hence the authors have predominantly focused on Thangaratinam et al's (2012) review, as it appears to be the most comprehensive in categorising the interventions and reporting the findings in the context of clinical benefit with practical implications.

Identified reviews report that lifestyle interventions improve outcomes with regard to maternal gestational weight gain, although the effectiveness may differ across BMI categories and between studies. All reviews indicated that existing evidence on dietary or PA interventions in reducing gestational weight gain are low quality and further research with adequate sample size and appropriate design and a better standard of reporting is required.

Discussion

Overall, dietary interventions seem to be more effective in reducing gestational weight gain with some improvement in clinical outcomes (for example, reducing the risk of gestational diabetes, gestational hypertension and shoulder dystocia). PA also has a role to play, however, issues were raised around low compliance and concerns over limited understanding of its full impact on birthweight.

PA interventions – less effective than expected

Thangaratinam's inference that dietary interventions demonstrate greater efficacy than either PA or mixed dietary/PA interventions, presents a point of interest that may benefit from further analysis (Thangaratinam et al, 2012). Why, in the context of weight management, where exercise is well-

documented to be an effective and essential component of maintaining a healthy weight (NICE, 2010, 2006), should those interventions incorporating PA show less effect than a purely dietary intervention during pregnancy?

A Health & Social Care Information Centre survey (2013) found that 32% of adult women self-reported that they met the government's PA recommendation, with lowest levels of activity in obese adults. Studies using accelerometry have found actual PA to be much lower than self-reported with 4% of women meeting the recommendations (Health & Social Care Information Centre, 2013). With so few women participating in PA, it is not a surprise that attempting to initiate active behaviours during pregnancy may present some difficulty.

Pregnancy is often cited as an opportune moment for instigating healthy behaviours, with concerns over both the mother's and baby's health acting as a motivator towards lifestyle change (de Jersey et al, 2011; Keating, 2011; Olander et al, 2011; Oteng-Ntim et al, 2010; Verbeke and de Bourdeaudhuij, 2007).

However, for some women, pregnancy is an opportunity to be liberated from the social body image ideal and freed from constraint in eating behaviours (Olander et al, 2011; Knight and Wyatt, 2010). Such dichotomous attitudinal positions present a challenge to healthcare practitioners involved in advising pregnant women.

Awareness of the above issues is important for healthcare professionals when offering diet and activity advice, and interventions during pregnancy. Midwives, having a unique opportunity in building relationships and being in contact with women for a relatively long period of time, should in particular be encouraged to use established behaviour change techniques (Michie et al, 2013) in promoting a healthy lifestyle for women and their families.

Compliance with PA

PA interventions during pregnancy may fail to produce statistically significant results for numerous reasons.

The PA interventions included in the Thangaratinam et al (2012) review consistently reported high rates of attrition, ranging from 10% to 32%. Of those studies that documented reported reasons for dropout, issues around time commitments, attendance of appointments and a lack of willingness to exercise during pregnancy were all cited.

Several studies involved participants who were recruited on the basis of their pre-existing sedentary lifestyle (Haakstad and Bo, 2011; Barakat et al, 2009; Garshasbi and Faghih, 2005; Marquez-Sterling et al, 2000). Whereas dietary interventions rely on the modification of a current behaviour (eating) that is common to all individuals, PA interventions often involved the adoption of a new behaviour (exercise), which typically requires a greater degree of motivation and determination to achieve.

The intensity of recommended PA is typically such that it produces discomfort in the form of breathlessness, warmth and, potentially, mild musculoskeletal soreness. These add to common pregnancy symptoms, particularly if women are not used to having physical activities in their

usual everyday life. It also requires a time commitment, equipment, access to facilities, child care and so forth. Such logistical, subjective and financial barriers to participation in PA exist where they do not for home-based dietary interventions, perhaps offering explanation for the poor outcome of PA interventions.

Within the UK, NICE (2010) explicitly recommends that, for the purposes of achieving and maintaining a healthy weight, activity should be built into daily life. Of the 14 exercise-based interventions measuring weight gain in pregnancy as a primary outcome included in Thangaratinam's review, only one specified that the intervention included advice around maintaining an active lifestyle (Haakstad and Bo, 2011) with all others focusing on structured exercise such as water/land aerobics or toning/resistance exercise. Such an approach, while methodologically justifiable within the context of the individual studies, does not reflect best practice guidelines within the UK, and as such is of questionable relevance to the delivery of maternity services.

Why were dietary interventions effective and favoured?

Dietary interventions in overweight and obese pregnant women follow dietary recommendations for the general population, with some interventions reducing energy intake by up to 30% (Rae et al, 2000); others increasing consumption of fruit, vegetables and whole grains; or keeping a healthy ratio of fat, protein and complex carbohydrates ranging from 30%/15%/55% (Wolff et al, 2008) to 40%/30%/40% (Asbee et al, 2009; Thornton et al, 2009). Reduced energy intake should slow gestational weight gain, as the mother would partially mobilise her fat stores for energy, but a fetus needs more than just energy to thrive.

Total energy intake and dietary fat are only part of a complex diet. Correct levels of micronutrients, such as folate, iron, calcium, vitamin D and omega 3 fatty acids (Thompson et al, 2010; Baker et al, 2009), may be more important for optimal fetal development than the mother's bodyweight or gestational weight gain, with only one study (Wolff et al, 2008) providing all participants with supplements.

The glycaemic index (GI) is a system for ranking carbohydrate rich foods from one to 100, based on overall effect on blood glucose levels (Diabetes UK, 2012). Lower GI foods take longer to be digested providing a more steady supply of glucose over a longer time period compared to high GI foods, which cause a sharp rise and then fall in glucose levels. Some studies have shown that low GI diets have a positive effect on cholesterol levels and reduce the risk of heart disease or possibility of developing type 2 diabetes (Lui et al, 2000; Salmerón et al, 1997). Therefore, low GI diets have been used in some dietary interventions during pregnancy. Clapp et al (1997) found their lower GI group had increased placental growth, less gestational weight gain and lower birthweights, but larger studies into GI diets are needed. A few studies, such as Guelinckx et al (2010), covered emotional eating and limiting binge eating so considering the psychological aspects of food as well as the energy content.

Compliance with dietary advice

Dietary interventions used a range of data collection methods to measure dietary intakes, including computer-assisted self-interview (Bechtel-Blackwell, 2002) in the home, diet recalls and food frequency questionnaires (Briley et al, 2002), food diaries (Thornton et al, 2009; Wolff et al, 2008; Khoury et al, 2005) and interviews. Completing a food diary for long periods of time (Khoury et al, 2005), or receiving feedback on your current diet (Phelan et al, 2011) can modify intake.

Asbee et al (2009) offered one lifestyle consultation with a dietitian and weight monitoring with feedback. Those in the intervention group who did not follow the dietary guidance had significantly heavier babies. Studies such as Wolff et al (2008) and Briley et al (2002) found those who did drop out stated the time commitment to attend appointments or complete all the tools was the issue. Reported compliance with dietary interventions ranged from 75% to >90%, with diets generally easier to follow than PA regimes. Dietary interventions ranged from 10 times one-hour personal appointments with a dietitian (Wolff et al, 2008) to five-minute brief interventions with a food technologist (Quinlivan et al, 2011b). Briley et al (2002) used six structured home visits by a nutritionist for assessment and counselling which improved the iron status and birthweight, but would be very expensive to implement within the NHS.

Intervention design

The design of interventions should take account of the benefits for the women of face-to-face time with a health professional or attending a group nutrition counselling or exercise session, against the costs to women and the health service in terms of time, effort and transport. If there are too many appointments to attend, the women may struggle or lose interest, but too few interactions and the intervention may have little effect. The same participant time and effort commitment could be argued for completing food diaries, activity logs, using pedometers or regular weighing, with the women most likely to be motivated and engaged if they are to receive feedback and can see a personal benefit. Interventions need to be designed to be accessible by the women they wish to recruit, considering women's employment, family commitments and transport networks. From the existing reviews, evidence on the effectiveness of remote interventions using mobile technology (mobile phones or internet) on gestational weight management is limited and needs further investigation.

No intervention is immune to the culture and environment in which it is based. Women agreeing to take part in interventions will have their own ideas, attitudes, beliefs and views about pregnancy and child-rearing and how they 'should' behave to benefit their baby. Prioritising the baby's development and wellbeing as a motivator for women to adopt healthy behaviour during pregnancy is in line with explorative evidence from analysis of parenting forums' discussions about weight management in pregnancy (Arden et al, 2014). Women's ideas will have been formed over their lifetime and influenced by their peers, who may have been promoting healthy behaviours, such as being active or may

not have been so positive role models, by continuing to smoke and drink but still give birth to an apparently normal baby. These social norms will be considered when a woman reflects on the advice given during the intervention to modify her diet or activity levels. Culture can reinforce incorrect or outdated messages, such as the idea that you should 'eat for two' during pregnancy, or that women should rest excessively. These cultural beliefs need to be identified and the latest evidence no longer supporting these practices sensitively explained. Interventions must be designed to fit into a specific culture and population so may not be replicable globally, unless they are adapted to those cultures.

Limitations

Another issue worth noting is that many studies had not clearly reported which strategy, if any, was used, making comparisons impossible. Gardner et al (2011) identified goal setting, self-monitoring and providing feedback as common features of many of these interventions. Brown et al (2012) developed this theme by concentrating on goal-setting strategies and components of these, such as goal framing, goal proximity and performance feedback indicators. They found goal setting useful in helping women to manage gestational weight gain but, due to the wide variation in how goals were set and supported, it was not possible to identify which aspects of goal setting were most successful (Brown et al, 2012).

Michie et al (2013) developed a taxonomy for classifying key components of behaviour change interventions in health psychology research. The behaviour change taxonomy is a useful tool to identify key components of complex behaviour change interventions (for example, action planning, goal setting, social comparison) with the aim of being able to see which components or combinations of components are most effective. Future studies should clearly state what they have undertaken, using the standardised terms found in the behaviour taxonomy, so that other researchers can evaluate study component effectiveness. The lack of standardised terms in the maternal obesity intervention literature, and use of vague terms such as 'nutrition counselling', make the taxonomy hard to apply. Currie et al (2013) used the taxonomy to identify behaviour change techniques in PA interventions with goals and planning, shaping knowledge and comparison of outcome techniques used to maintain activity during pregnancy, but conclude that they cannot measure the effectiveness of each technique due to a lack of high-quality interventions. Using the behaviour change taxonomy, when analysing the effectiveness of gestational weight management clinical trials, merits further investigation.

Gestational weight management is a growing area of research with several large ongoing intervention trials. The Australian RCT called LIMIT, with 2212 participants, recently published findings in the *British Medical Journal* indicating a lack of effectiveness for their intervention on all outcomes except the incidence of macrosomia (>4000g) (Dodd et al, 2014). Due to the current level of research activity in the area of gestational weight management, continuous review of the topic is important.

Conclusion

PA has a role to play, however, in light of a low compliance and limited understanding of its impact on fetal growth and birthweight, more robust investigations are required to address the balance between its benefits and impact.

Most diet interventions looked at improving the diet quality by moving the woman's diet towards the ideal macronutrient profile and by eating more fruit and vegetables, with some studies looking at reducing energy intake, supplement use or GI diets, with no general consensus as to which approach is most effective and best adhered to by women. Reduced gestational weight gain should not be seen as the only benefit of dietary interventions, as improving nutrient intakes and encouraging women to develop more healthy eating habits and practices, will benefit mother and child during pregnancy and into the future.

Further research is required and, given the complex nature of obesity, a mono-method approach to investigating the topic is liable to overlook relevant aspects of the problem. Neither a qualitative nor quantitative approach can, in isolation, deliver a comprehensive overview of the issues pertinent to gaining understanding and establishing fact. As such, a mixed methods approach may provide greater insight, not only into the efficacy of interventions, but also into the context in which they succeed or fail.

Implications

Healthcare professionals, particularly midwives, should be offered support and training in understanding complexities of gestational weight gain management in conjunction with methods to motivate and encourage behaviour change for women during pregnancy.

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