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Applying Behavior Change Techniques to Weight Management During Pregnancy: Impact on Perinatal Outcomes

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Abstract

Unhealthy behaviors and lifestyle choices are contributing to the obesity epidemic and associated morbidities. Among reproductive aged women, obesity adversely affects perinatal outcomes and longer term maternal and child health. Interventions utilizing strategies of behavior change have the potential to improve outcomes, especially during pregnancy. Antenatal interventions to improve adherence to gestational weight gain guidelines are one such example. Although behaviorally-based intervention trials have been associated with modest decreases in gestational weight gain, the effect on short term perinatal outcomes has thus far been minimal. This commentary aims to discuss possible reasons behind the failure to improve perinatal outcomes as well as to encourage future areas of study.

Keywords

Pregnancy; obesity; gestational weight gain; antenatal interventions; behavior; behavior change; perinatal outcomes

The impact of unhealthy behaviors and lifestyle choices on adverse health outcomes and chronic disease is increasingly recognized. With approximately 40% of annual premature deaths in the United States (U.S.) attributable to behavioral causes, there is a growing need to prioritize health promotion and preventive strategies to optimize long-term health.^{1,2} Rates of obesity in the U.S. have reached an all-time high of 37.7%³ and it has been proposed that the medical complications associated with obesity may contribute to the recent plateauing of life expectancy among adults.^{2,4,5} Similar rates of obesity are observed among reproductive aged women.⁶ Perhaps more alarming, 17% of children between the ages of 2

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and 19 are obese,^{3,6} ranking the U.S. the highest in childhood obesity rates of 17 peer high income countries.^{1,2} Individual behaviors, including unhealthy food choices and sedentary lifestyles, are significant contributors to the rising rates of obesity and subsequent morbidity.

Maternal obesity is associated with adverse perinatal outcomes. Compared to women with a BMI 18.5–24.9 kg/m², those with a BMI ≥ 30 kg/m² have 2–3 fold increased risks of hypertensive disorders of pregnancy, cesarean delivery, fetal macrosomia, stillbirth, and infant mortality.^{7–14} Obese women with excessive gestational weight gain (GWG) are at even higher risk.¹¹ Both maternal pre-pregnancy BMI and excessive GWG are risk factors for childhood obesity in the first 1000 days.¹⁵ Children born to women with excessive, compared to adequate, weight gain are 30–45% more likely to be obese.^{16,17} Optimizing GWG, especially among obese gravidas, may minimize these risks. A motivating time period for many women, pregnancy provides a unique window of opportunity to engage in behavior change. Adopting healthy behaviors during pregnancy has the potential to not only improve immediate perinatal outcomes, but also confer benefit on long-term maternal and child health. This commentary aims to briefly summarize the impact of behavioral interventions on perinatal outcomes and to explore reasons behind why short term outcomes have thus far been minimally affected by clinical interventions. Further, we offer suggestions for future areas of study.

After the Institute of Medicine published updated GWG guidelines in 2009,⁷ which limited weight gain among obese women to 5–9 kg (11–20 lbs), it became apparent that many women, particularly overweight and obese women, are gaining too much weight during pregnancy.¹⁸ Numerous behaviorally-based intervention trials were subsequently undertaken in an effort to improve adherence with the guidelines and ultimately improve perinatal outcomes. At least six systematic reviews and meta-analyses have been published since 2011 examining antenatal dietary, exercise, and lifestyle interventions to target GWG.^{19–24} Overall, women participating in lifestyle interventions during pregnancy gain significantly less weight than those receiving usual obstetric care, with generally modest differences in weight gain of 1.4 to 2.2 kg.²⁵ Unfortunately however, the interventions have not significantly increased the proportion of women gaining within GWG guidelines and have had little, or no, effect on perinatal outcomes. A recent Cochrane Review reported an overall 20% decrease in GWG in women participating in antenatal interventions of diet, exercise, or both with no differences found in rates of cesarean delivery, macrosomia, or preterm birth.²⁵

Few randomized controlled trials have evaluated maternal or child outcomes related to weight *beyond* the immediate postpartum period. The Lifestyle in Pregnancy study²⁶ was a maternal lifestyle intervention that was successful at decreasing GWG and followed 150 offspring at a mean of 2.8 years after birth. There were no significant differences in BMI or metabolic risk factors noted in children born to mothers in the intervention compared to control groups. Three additional trials followed the offspring of women participating in antenatal intervention trials to 6–12 months of age.^{27–29} Again, no between-groups differences in infant weight were seen at follow up. Limitations of these trials included a high loss to follow up rate,^{26,28} baseline differences between groups,^{28,29} and minimal impact of the intervention on GWG.²⁸ The effect of antenatal lifestyle interventions on

maternal postpartum weight retention has also been under-studied. Limited data suggests a potential benefit although the optimal intervention remains unclear.^{27,28,30,31}

Despite epidemiologic data indicating that excessive GWG is associated with adverse outcomes, current intervention trials to improve GWG have been disappointing in their effect on perinatal outcomes. Before we conclude that antenatal behavior change has no impact on maternal and offspring health, critically evaluating the differences and limitations of the current literature seems warranted. Published antenatal intervention trials have varied widely, making it difficult to make meaningful comparisons between studies, with meta-analyses indicating mostly high levels of heterogeneity across included studies. The type and components of intervention trials differ greatly with some involving dietary^{21,32} or physical activity^{20,25,33} advice alone and others in combination.^{23,25} Dietary interventions may involve simple dietary advice, adherence to specific diets, or food journaling.³⁴ Physical activity components include the provision of advice, pedometers, personal trainers, or gym memberships. Some interventions included elements of evidence-based behavioral weight management²⁴ while others did not. In general, those studies that utilized behavioral weight-management strategies included combinations of journaling, motivational interviewing, support groups, and educational materials.³⁵ The frequency and duration of interventions during pregnancy were not uniform, ranging from frequent contact every 1–2 weeks to minimal interaction over the course of the pregnancy. The implementation of the interventions varied including who provided the intervention (nutritionists, therapists, nurses, physicians)^{36,37} and whether the intervention was in person or online^{38,39} or provided as individual or group sessions.^{29,40} Thus, the optimal intervention type is unknown. A systematic review concluded that dietary interventions, particularly when accompanied by behavior change strategies, are most effective at minimizing excessive GWG.⁴¹ The authors also indicated that a combination of multiple (4–5) behavior change techniques including provision of information, self-monitoring of behavior, and providing rewards contingent on successful behavior may be strategies that offer the greatest benefits.⁴¹ Given the modest overall effect of current interventions on GWG, there is a need to identify novel and efficacious strategies as larger differences in GWG may in fact lead to measurable improvements in perinatal outcomes. One approach may be through the addition of financial incentives to multi-element interventions. Effective in promoting smoking cessation in pregnant women^{42–44} and weight loss in *non-pregnant* obese adults,^{45,46} incentives may augment the results achieved in GWG trials. Although criticized due to their inability to maintain long-term weight loss once removed, incentives during pregnancy, a limited period of time, could be effective in improving perinatal outcomes.

Another limitation of current studies is the lack of uniformity in inclusion criteria. Inclusion criteria have varied with some studies enrolling women of all BMI categories and others only normal⁴⁷ or overweight/obese gravidas.^{22,24} Individual trials also differ in their inclusion of racial and ethnic minorities,⁴⁸ disadvantaged women⁴⁹ and women with medical comorbidities including diabetes.²⁴

The timing of initiation of intervention trials may also limit their success at improving perinatal outcome. Catalano et al⁵⁰ argue that maternal metabolic health must be optimized prior to conception. Early pregnancy obesity and decreased insulin sensitivity result in

increased nutrient availability and fetal overgrowth. These normal maternal physiologic adaptations to pregnancy may not be able to be overcome by behavioral interventions alone.⁵⁰ Most published intervention studies have included women well into the second trimester where effects may indeed be limited.²² However, there is some evidence that early interventions, initiated during the first trimester, are associated with greater success at limiting GWG.⁵¹

Although current interventions have shown little benefit on examined perinatal and neonatal outcomes, the rarity of some outcomes (ie: stillbirth and infant mortality) may preclude a large enough trial to detect a difference. That said, other outcomes that have been less well studied may indeed have the potential to be discernibly impacted. For example, other complications of maternal obesity including venous thromboembolism, wound infection, and postpartum hemorrhage have not been primary outcomes examined in GWG trials. Additionally, gestational weight gain is associated with greater infant fat mass;⁵² limited examination of the effect of antenatal interventions on fetal and neonatal fat accretion have shown mixed results.^{53–55} Most intervention studies have not followed women or their offspring beyond the immediate postpartum period. Thus, the potential longer-term effects of the intervention are currently unknown, particularly as they relate to infant and child obesity. The impact of interventions on neonatal/infant appetite and metabolism as well as in utero epigenetic modifications are potential areas of further study. For example, observational data indicates that genomic methylation varies according to birthweight.^{56–58} In experimental animal studies, changes in maternal diet affect offspring methylation⁵⁹ and, in at least one clinical study, methylation patterns in umbilical cord tissue at birth were associated with maternal diet and childhood adiposity.⁶⁰ Epigenetic changes have the potential to serve as a proxy between maternal and child obesity.

More recently, behavioral interventions are being studied periconceptually and postnatally. Most preconception efforts have focused on weight loss in women with polycystic ovary syndrome and infertility.^{24,61–64} While these, as well as postpartum interventions, are associated with improvements in weight outcomes, the effects on longer-term maternal and child health are not yet known.^{31,65–67} Interventions to prevent childhood obesity are also being undertaken in infancy.^{68–70} The INSIGHT Responsive Parenting Intervention, for example, randomized primiparous mother-newborn dyads to the intervention vs safety control. The intervention, focused on infant soothing, sleeping, and feeding, was associated with less rapid weight gain, a lower mean weight for length percentile, and a decreased prevalence of infant overweight status at 1 year of age.⁷¹ It may be that a combination of approaches, targeting preconception weight, GWG, and healthy behaviors in parents and children has the greatest potential to reduce childhood obesity.

Rather than conclude that antenatal interventions are ineffective at improving perinatal outcomes, ongoing efforts to improve adherence to gestational weight gain guidelines should include identification of critical intervention elements that are associated with improved success, evaluation of patient characteristics that predict success, and examination of longer-term effects of interventions on maternal and child weight. Collaborative research, such as that of the International Weight Management in Pregnancy (i-WiP) Collaborative Group^{72,73} and the Lifestyle Interventions for Expectant Moms (Life-Moms) consortium⁷⁴ may provide

important insight. The i-WiP collaborative group is performing an individual patient level meta-analysis of randomized controlled trials evaluating antenatal interventions with a goal to determine the differential effects of interventions in population subgroups according to pre-pregnancy BMI, age, ethnicity, parity, and co-morbid medical conditions. LIFE-Moms, a research consortium of 7 independent clinical trials of interventions to improve GWG, will include data sharing and direct comparison of interventions. Efforts such as these should continue to be encouraged. Most likely, periconceptual lifestyle changes, as well as novel approaches, will need to be combined to improve the adverse maternal and child health outcomes associated with maternal obesity and overnutrition.

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Highlights

- Unhealthy behaviors contribute to the growing obesity epidemic
- Poor lifestyle choices and obesity increase the risk of adverse perinatal outcomes
- Behavioral interventions to minimize pregnancy weight gain have had limited effect
- This may be due to differences in antenatal trials and lack of long term follow-up
- Multi-faceted interventions throughout the reproductive years may improve outcomes