

Gestational weight gain and long-term postpartum weight retention

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Background: Excessive gestational weight gain is related to postpartum weight retention and multiple short- and long-term adverse outcomes. These include pregnancy related complications as preeclampsia and higher rates of cesarean delivery and long-term morbidities as future obesity and metabolic syndrome. Even so, more than half of the pregnant women gain excessive weight during their pregnancy. **Methods:** This review included a database search of Medline, ClinicalKey, PubMed, PubMed Central, Scopus, Ovid, and the Cochrane Database of Systemic Reviews. We included original articles, systematic reviews and meta-analysis published in peer-reviewed journals between January 1990 and October 2020 that addressed the correlation between excessive gestational weight gain, postpartum weight retention and maternal health issues. Only articles published in the English language that were available at full length, were included in this review. **Results and discussion:** After reviewing the literature, we discuss the risk factors for excessive gestational weight gain, the association between excessive gestational weight gain and postpartum weight retention and the implications of excessive gestational weight gain on women's future health. Finally, we highlight future research opportunities related to these issues.

Keywords

Gestational weight gain; Excessive; Postpartum weight retention; Obesity

1. Introduction

Pregnancy leads to diverse physiological changes that impact both mother's and offspring's future health. One of the most prominent changes, is gestational weight gain (GESTATIONAL WEIGHT GAIN).

Excessive gestational weight gain, defined as pregnancy weight gain above the IOM 2009 recommendations, is associated with multiple short- and long-term adverse outcomes.

Short-term pregnancy related adverse outcomes include gestational diabetes, pre-eclampsia and higher rates of cesarean delivery [1–6]. Offspring of women with excessive gestational weight gain are twice as likely to be large for gestational age and to suffer from future childhood overweight and obesity [7]. Increased risks of neonatal hypoglycemia, low Apgar scores, seizures, polycythemia and meconium aspiration syndrome were described as well [2–6, 8–11].

Maternal long-term adverse outcomes include postpar-

tum weight retention [1] and other proposed metabolic consequences as type-2 diabetes, cardiovascular disease and metabolic syndrome [12].

2. Gestational weight gain recommendations

Gestational weight gain recommendations are based historically on the 1990 Institute of Medicine (IOM 1990) guidelines [13]. These guidelines aimed at increasing the likelihood of delivering a term live-born infant with an appropriate birth weight, by avoiding inadequate gestational weight gain. Since 1990, several changes occurred. Women who enter pregnancy became older and much more overweight and obese. Thus in 2009, the IOM guidelines were revised to focus on meeting and not exceeding the goals of gestational weight gain [1]. The 2009 committee considered the optimization of gestational weight gain to ensure the optimal tradeoff between adequate fetal growth and the potential for maternal overweight and obesity. Women's pre-pregnancy body mass index (BMI) was categorized using the WHO/NHLBI (World Health Organization/ National Heart, Lung, and Blood Institute) cutoff points [underweight <18.5 kg/m², normal weight (18.5–24.9 kg/m²), overweight (25.0–29.9 kg/m²), obese ≥30 kg/m²] and ranges of recommended weight gain were provided accordingly. For underweight, normal weight, overweight and obese women, the recommended gestational weight gain was defined as 28–40 lbs (13–18 kg), 25–35 lbs (11–16 kg), 15–25 lbs (7–11 kg) and 11–20 lbs (5–9 kg) accordingly. The 2009 committee [1] also made a recommendation that all women strive to be within the normal BMI range when they conceive.

The IOM 2009 guidelines are the most frequently used to counsel pregnant women regarding recommended gestational weight gain. While widely accepted, these guidelines lack data and recommendations for special populations such as women with class II or class III obesity. Other studies point that women with extreme obesity might benefit from a lesser weight gain than recommended by IOM 2009 guidelines or even weight loss without increasing the rates of preterm labor and small for gestational age neonates [14–18].

In 2019, new thresholds for gestational weight gain were suggested, based on the Life Cycle Project Study Group

meta-analysis. The BMI categories were further subdivided into [underweight $<18.5 \text{ kg/m}^2$, normal weight ($18.5\text{--}24.9 \text{ kg/m}^2$), overweight ($25.0\text{--}29.9 \text{ kg/m}^2$), obese class-I ($30\text{--}34.9 \text{ kg/m}^2$), obese class-II ($35\text{--}39.9 \text{ kg/m}^2$) and obese class-III ($\geq 40 \text{ kg/m}^2$)]. For underweight, normal weight, overweight and obese class-I, II and III women, the recommended gestational weight gain was defined as 31–35 lbs (14–16 kg), 22–40 lbs (10–18 kg), 4–35 lbs (2–16 kg), 4–13 lbs (2–6 kg), 0–9 lbs (0–4 kg) and 0–13 lbs (0–6 kg) respectively [19]. The new recommended thresholds for each BMI class were found to be associated with lower risks of select adverse outcomes including preeclampsia, gestational hypertension, gestational diabetes, cesarean delivery, preterm birth and small or large for gestational age at birth. These newer guidelines though have still not been routinely implemented into clinical practice.

3. Adherence to guidelines

Guidelines regarding the recommended weight gain in pregnancy are well established and promoted worldwide [20]. Despite this, many women begin pregnancy overweight or obese and as many as 50% gain excessive weight during pregnancy. Only one third of pregnant women gain weight according to guidelines [8, 21–26].

There are few possible explanations to this finding. Some are health-care system related while others appear to be patient related. From a health care system perspective, there is a lack of uniformity and a wide variety of gestational weight gain guidelines worldwide. A study by Alavi N *et al.* [20] was able to identify guidelines for 31% of the countries in the world. Approximately half of those guidelines had similar gestational weight gain recommendations to the 2009 American Institutes of Medicine (IOM) guidelines. Another issue is patient awareness of gestational weight gain recommendations. Several studies have shown that only half of the pregnant women are aware of the local gestational weight gain recommendations and approximately one-third report that their primary Obstetric caregiver rarely or never offered counseling on this matter [27–30]. It was shown that even among the minority of patients who receive advice, about one third receive advice that is inconsistent with IOM guidelines. For example, 50% of the overweight and obese patients were advised to over gain, while some 35% of the low BMI patients were advised to under gain [27]. Medical advice regarding gestational weight gain seems to be infrequent and inaccurate, with discrepancies between geographic regions, patient populations, and healthcare disciplines [31].

4. Causes for excessive gestational weight gain

Several risk factors for excessive gestational weight gain have been identified.

Pre-pregnancy overweight and obesity are well established risk factors for excessive gestational weight gain [32, 33]. Deputy *et al.* [34] showed in their analysis that 47.2%

of all women had excessive gestational weight gain. Overweight and obese class I (BMI $30\text{--}34.9 \text{ kg/m}^2$) women had the highest prevalence of excessive gestational weight gain (64.1% and 63.5% respectively). Similar findings have been found in additional studies [35, 36].

Nulliparity is another a risk factor for excessive gestational weight gain as shown in a cohort study of 1950 pregnant women in New-Zealand. As many as 74.3% of this nulliparous cohort of women demonstrated excessive gestational weight gain [21]. In another study nulliparous women had and increased risk (OR 1.49, CI 1.08–2.04) of gaining excessive weight in comparison to multiparous women [37].

There are known racial-ethnic variances in pre-pregnancy weight and gestational weight gain among reproductive-age women. The highest rate of pre-pregnancy overweight is found among non-Hispanic Black (80%) and Hispanic (69.5%) women, followed by White (55%) and Asians (26%) [38]. These women tend to gain less absolute weight in pregnancy than White women [39–41], however as they tend to have a higher early pregnancy BMI they still have similar rates of gestational weight gain above IOM guidelines [42, 43].

Psychological factors have been studied and shown to affect gestational weight gain. Factors such as negative body image and attitude towards weight gain, concern about weight gain, inaccurate perceptions regarding weight, and less knowledge about weight gain recommendations were all shown to correlate with excessive gestational weight gain [44, 45].

Lifestyle behaviors and eating patterns, have also been found to affect excessive gestational weight gain. Women who tend to eat “much more” in pregnancy in comparison to only “a little more”, women who are less physically active, women whose diet is high in fat and carbohydrate intake and low in fiber intake are more likely to gain excessive gestational weight [36, 46–49].

Not surprisingly, socio-economic status and level of education correlate in an adverse manner with excessive gestational weight gain as well. Lower educated women with a healthy pre-pregnancy BMI are at greater risk of excessive gestational weight gain. Nearly half of women with an elementary or secondary education gained weight excessively in comparison to women with higher education levels [33]. The impact of excessive gestational weight gain on postpartum weight retention was found to be three times greater in lower income women than it was in higher income women [36].

5. Excessive gestational weight gain and Postpartum weight retention

Excessive gestational weight gain is shown to be the strongest risk factor for postpartum weight retention [1, 32, 50–54].

Since the post-partum period of the first pregnancy becomes the pre-conception period of the next pregnancy, mothers begin the subsequent pregnancy at a higher BMI and

thereby increase their risk for excessive gestational weight gain and increased post-partum BMI. Thus, excessive weight gain during pregnancy, especially the first pregnancy, is an independent risk factor for new or persistent obesity in women [12, 55]. This vicious cycle of repeated weight gain explains the increased prevalence of overweight and obesity in reproductive age women [56–59].

Obesity is known to be associated with multiple adverse perinatal outcomes as miscarriage [60], stillbirth [61, 62], congenital anomalies [63], preeclampsia [61, 62, 64], gestational diabetes mellitus [62, 64], fetal macrosomia [62, 64] and cesarean section delivery [61, 62, 64, 65].

Lifelong adverse outcomes of obesity include chronic hypertension, dyslipidemia, type-2 diabetes mellitus, ischemic heart disease, cancer and shorter life span [1, 36, 42, 66–71].

First trimester excessive gestational weight gain is most correlated with postpartum weight retention, higher waist circumference and elevated blood pressure at 3 and 7-years follow up, than second- or third-trimester gain [72]. Women with a normal preconception BMI have as much as 70% probability of excessive gestational weight gain when excess weight gain is experienced in the first trimester [73].

The risk for postpartum weight retention correlates positively in a dose dependent manner with the degree of excessive gestational weight gain. In a cohort of obese women, the risk of a postpartum weight retention greater than 10 pounds was twofold higher for women gaining greater than 15 to 25 pounds, fourfold higher for women gaining greater than 25 to 35 pounds, and almost eightfold higher for women gaining greater than 35 pounds [74].

6. Excessive gestational weight gain, adiposity, and future health

It is important to note that not only weight but also, body composition changes following pregnancy and gestational weight gain. Observational studies [55] generally support an association between pregnancy and long-term adiposity in the mother, particularly for women who already have obesity when beginning pregnancy. It is also shown that total fat mass and visceral fat increases following pregnancy and remains 4% and 33% above preconception values post-partum, respectively [75].

Some studies correlate between excessive gestational weight gain and future adiposity. Sohlstrom and Forsum assessed adipose tissue volume among Swedish women before pregnancy and 5–10 days and 2, 6 and 12 months postpartum using magnetic resonance imaging. They showed that women with excessive pregnancy weight gain (>20 kg) gain up to 10.8 ± 2.1 kg of adipose tissue. Much more than women with adequate gestational weight gain [76, 77].

Adiposity and visceral adipose tissue appear to be specific metabolic risk factors [78, 79] and independent risk factors for type-2 DM and metabolic syndrome [80].

Thus, recent studies examined not only the correlation between excessive gestational weight gain to postpartum

weight retention but also between excessive gestational weight gain and abdominal adiposity and other medical complications.

For example, Shinar *et al.*, measured the variation between first trimester and postpartum visceral adipose tissue (VAT) thickness and examined the relationship to changes in BMI and postpartum insulin resistance. They found that net VAT gainers exhibited significantly poorer pregnancy insulin sensitivity and trended toward having worse glucose handling postpartum.

Candace *et al.* showed in their study that women with excessive gestational weight gain had a 3.6-kg (1.5, 5.6) greater weight change, a 3.2-cm (1.2, 5.2) greater waist circumference, and 3-fold greater odds of abdominal obesity (2.9; 1.6, 5.1) compared with women who gained weight as recommended. This acquired maternal abdominal adiposity, may increase a woman's future risk of cardiovascular and metabolic disease [24]. Fraser *et al.*, showed in their study, that women with excessive gestational weight gain had 3-fold increased odds of overweight and central adiposity, as well as higher systolic and diastolic blood pressure later in life.

7. Conclusions

To conclude, Women who gain excessive weight during pregnancy are at a risk for postpartum weight retention, overweight and obesity, increased subcutaneous and visceral adiposity. Subsequently, these women are exposed to future health problems such as type-2 DM, metabolic syndrome, and cardiovascular disease later in life.

There are well identified risk factors for excessive gestational weight gain. These include pre-pregnancy overweight or obesity, nulliparity, ethnicity and low socio-economic status. Another possible contributing factor is the provision of inaccurate or inadequate education regarding recommended gestational weight gain by health care providers. Pregnancy is an opportunity to improve future health for two generations, mother, and offspring. It is also a time when women interact frequently with the health care system providing a unique opportunity to increase health awareness and modify lifestyle when indicated.

Additional research is needed to identify more effective methods to reduce excessive gestational weight gain as these interventions have the potential for significant downstream health benefits by reducing postpartum weight retention and subsequent obesity.

Author contributions

AB: Data search, data review and manuscript writing. HB: Data Review and manuscript editing.

Ethics approval and consent to participate

Not applicable.

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Conflict of interest

The authors declare no conflict of interest.

Condensation

Women who gain excessive weight in pregnancy are at a risk for postpartum weight retention and future obesity.

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