# Distribution of pregnancy-related weight measures

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## Abstract

***Objective*** To describe the distribution of prepregnancy body mass index (BMI), gestational weight gain, and interpregnancy weight change.

***Design*** Descriptive epidemiologic study using the Nova Scotia Atlee Perinatal Database.

***Setting*** Nova Scotia, 2003 to 2013.

***Participants*** Included were 63 355 pregnancies in women aged 20 years and older. Analyses of gestational weight gain were restricted to 54 289 singleton pregnancies. Analyses of interpregnancy weight change included 22 890 pairs of successive pregnancies.

***Main outcome measures*** Prepregnancy BMI; gestational weight gain (the difference between delivery and prepregnancy weight adjusted for length of gestation); and interpregnancy weight change (the difference in prepregnancy weight between successive pregnancies).

***Results*** The median (interquartile range [IQR]) prepregnancy BMI was 24.7 kg/m$^2$ (21.7 to 29.4 kg/m$^2$). Fewer than half (48.5%) of the pregnancies were in normal-weight women, 24.6% were in overweight women, and 23.0% were in obese women. The median (IQR) weight loss needed for women who entered pregnancy overweight or obese to be within the normal range was 13.2 kg (5.7 to 25.2 kg). The median (IQR) gestational weight gain was 14.9 kg (11.0 to 19.1 kg). Inadequate weight gain was observed in 15.8% of women and of these women, half were below the recommended amount by at least 2.2 kg. Excess gestational weight gain was observed in 57.9% of pregnancies, and among these, half were above the recommended amount by at least 4.8 kg. The median (IQR) interpregnancy weight change was 2.3 kg (-0.9 to 6.8 kg). Most (57.2%) women gained more than 1 kg between pregnancies and 24.6% lost 1 kg or more between pregnancies.

***Conclusion*** In Nova Scotia, both inadequate and excess pregnancy-related weight are prevalent, although the latter is more common than the former. Strategies are needed to promote healthier weight in reproductive-aged women, optimize gestational weight gain, and support postpartum weight management.


### EDITOR'S KEY POINTS

- Few Canadian provinces have perinatal registries, but population-based estimates of pregnancy-related weight can be derived from Nova Scotia's Atlee Perinatal Database. This study drew from the database to describe prepregnancy body mass index (BMI), gestational weight gain, and interpregnancy weight change in the province.

- Substantial proportions of pregnant women have prepregnancy BMIs categorized as overweight or obese, gain more weight than is recommended in pregnancy, and enter their next pregnancy weighing more than they did before their previous pregnancy.

- These data show that women who are overweight or obese would need to lose a substantial amount of weight to reach a BMI in the normal range. The relationship between BMI and most adverse outcomes is continuous, so incremental advances toward optimal weight would have positive effects on outcomes.

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# Profil des mesures du poids associé à la grossesse

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## Résumé

***Objectif*** Décrire le profil de l'indice de masse corporelle (IMC) avant la grossesse, du gain pondéral gestationnel et du changement de poids d'une grossesse à l'autre.

***Conception*** Étude épidémiologique descriptive à l'aide de la base de données périnatales Atlee de la Nouvelle-Écosse.

***Contexte*** Nouvelle-Écosse, de 2003 à 2013.

***Participantes*** Les données portaient sur 63 355 grossesses chez des femmes de 20 ans et plus. Les analyses du gain pondéral gestationnel se sont limitées à 54 289 grossesses uniques. Les évaluations du changement pondéral d'une grossesse à l'autre portaient sur 22 890 paires de grossesses successives.

***Principaux paramètres à l'étude*** L'IMC avant la grossesse; le gain pondéral gestationnel (la différence entre le poids à l'accouchement et celui avant la grossesse ajusté en fonction de la durée de la gestation); et le changement de poids d'une grossesse à l'autre (la différence entre le poids avant la première grossesse et celui avant la grossesse subséquente).

***Résultats*** L'IMC moyen (intervalle interquartile [IIQ]) avant la grossesse était de 24,7 kg/m$^2$ (21,7 à 29,4 kg/m$^2$). Dans moins de la moitié (48,5 %) des grossesses, les femmes étaient de poids normal, dans 24,6 % des cas, les femmes avaient un surpoids et dans 23 % des cas à l'étude, les femmes étaient obèses. La perte pondérale moyenne (IIQ) nécessaire pour que les femmes qui commençaient leur grossesse ayant un surpoids ou étant obèses aient un poids normal se situait à 13,2 kg (5,7 à 25,2 kg). Le gain pondéral gestationnel moyen (IIQ) était de 14,9 kg (11 à 19,1 kg). Un gain de poids insuffisant a été observé chez 15,8 % des femmes et, chez la moitié de ces dernières, l'insuffisance de poids était d'au moins 2,2 kg inférieur au gain de poids recommandé. Un gain pondéral gestationnel excessif a été observé dans 57,9 % des grossesses et, parmi la moitié d'entre elles, le gain dépassait l'augmentation recommandée d'au moins 4,8 kg. Le changement pondéral moyen (IIQ) d'une grossesse à l'autre était de 2,3 kg (-0,9 à 6,8 kg). La plupart (57,2 %) des femmes avaient pris plus de 1 kg et 24,6 % avaient perdu 1 kg ou plus entre les grossesses.

***Conclusion*** En Nouvelle-Écosse, les gains de poids insuffisants et excessifs associés à la grossesse sont tous 2 courants, quoique le dernier cas soit plus fréquent que le premier. Il faut des stratégies pour promouvoir un poids plus sain chez les femmes en âge de procréer, optimiser le gain pondéral gestationnel et soutenir la prise en charge du poids après l'accouchement.


### POINTS DE REPÈRE DU RÉDACTEUR

- Peu de provinces canadiennes disposent d'un registre périnatal, mais il est possible de calculer des estimations populationnelles du poids associé à la grossesse à partir de la base de données périnatales Atlee de la Nouvelle-Écosse. Dans la présente étude, on s'est servi de cette base de données pour décrire l'indice de masse corporelle (IMC) avant la grossesse, le gain pondéral gestationnel et le changement de poids d'une grossesse à l'autre dans la province.

- Des proportions considérables de femmes enceintes avaient un IMC avant la grossesse qui se classait dans la catégorie du surpoids ou de l'obésité, ont pris plus de poids que ce qui est recommandé durant la grossesse et ont commencé leur grossesse subséquente pesant plus qu'avant leur dernière grossesse.

- Ces données démontrent que les femmes qui ont un surpoids ou sont obèses devraient perdre une quantité substantielle de poids pour atteindre un IMC considéré normal. La relation entre l'IMC et les issues les plus indésirables est constante. Des efforts progressifs pour atteindre un poids optimal auraient donc des effets positifs sur les résultats.

Cet article a fait l'objet d'une révision par des pairs.
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High body mass index (BMI) is one of the modifiable risk factors that contributes most substantially to morbidity and premature mortality through its influence on the development of a range of chronic diseases including hypertension, diabetes mellitus, several cancers, and cardiovascular disease.[1] As well, elevated maternal BMI increases the risk of many perinatal adverse outcomes, including gestational diabetes mellitus,[2] preeclampsia,[3] cesarean section,[4] congenital anomalies,[5] fetal macrosomia,[3,6] preterm birth,[6] and perinatal death,[7] as well as childhood obesity.[8] Excess maternal weight gain throughout pregnancy further contributes to the risk of many of these outcomes.[9] This gestational weight gain and the subsequent failure to return to prepregnancy weight can contribute to adiposity-related risks in subsequent pregnancies[10,11] and to women's lifelong weight gain trajectories and their development of chronic disease.[12]

In recognition of the perinatal risks associated with prepregnancy excess weight, the Society of Obstetricians and Gynaecologists of Canada (SOGC)[13] states that women should ideally enter pregnancy with a BMI less than 25 kg/m$^2$. Recommendations for gestational weight gain in singleton pregnancies have also been made by the US Institute of Medicine[9] and adopted by Health Canada.[14] These depend on a mother's prepregnancy BMI: those who are underweight should gain 12.5 to 18.0 kg; those who are normal weight should gain 11.5 to 16.0 kg; those who are overweight should gain 7.0 to 11.5 kg; and those who are obese should gain 5.0 to 9.0 kg.

Although pregnancy-related weight has been recognized as an important indicator of perinatal health,[15] ongoing national surveillance is not yet possible because few Canadian provinces have perinatal registries in which maternal height and weight are recorded.[16-22] Our objective, therefore, was to describe 3 measures of pregnancy-related weight (prepregnancy BMI, gestational weight gain, and interpregnancy weight change) in Nova Scotia, a province with a long-standing perinatal database.[23] We described prepregnancy BMI and gestational weight gain not only in relation to SOGC[13] and Health Canada[14] guidelines, but also with respect to the weight differences that would be needed for current recommendations to be met, in order to put the scope of the problem into context.

## METHODS

### Population

This descriptive study used the Nova Scotia Atlee Perinatal Database, which includes all deliveries by residents of Nova Scotia. Trained coders enter data including basic demographic variables, reproductive history, and perinatal outcomes from standard provincial prenatal and hospital admission forms. The Reproductive Care Program of Nova Scotia administers the database, maintains the coding system, and ensures the high quality, integrity, and security of the data. Periodic abstraction and validation studies form an ongoing data quality assurance program.[24]

Included in the analysis were pregnancies to nonadolescent women (20 years or older) that resulted in deliveries of infants with birth weights of 500 g or greater and gestational ages of 20 weeks or greater. The time period was from 2003, when maternal height was introduced into the Atlee Perinatal Database, to 2013, the end point for when complete and verified data were available. Analyses of gestational weight gain were further restricted to singleton pregnancies, to which the guidelines are directed. Analyses of interpregnancy weight change were restricted to mothers who had a previous pregnancy recorded. This study was reviewed and approved by the Reproductive Care Program Data Access Committee and the IWK Health Centre Research Ethics Board.

### Measures

Prepregnancy BMI was calculated as prepregnancy weight (kg) divided by the square of height (m$^2$) and categorized as underweight (<18.5 kg/m$^2$); normal weight (18.5 to <25.0 kg/m$^2$); overweight (25.0 to <30.0 kg/m$^2$); obese, class I (30.0 to <35.0 kg/m$^2$); obese, class II (35.0 to <40.0 kg/m$^2$); and obese, class III (≥40.0 kg/m$^2$).[25] Among women with a BMI not in the normal-weight category, we also calculated the weight change that would have been necessary to achieve a normal prepregnancy BMI (ie, the gain needed for underweight women to reach a BMI of 18.5 kg/m$^2$ and the loss needed for overweight and obese women to reach a BMI of 24.9 kg/m$^2$). We estimated gestational weight gain for a 40-week gestation to account for differing lengths of gestation by assuming a 2.0-kg gain in the first trimester[9] and using the rate of weight gain thereafter. Specifically, the equation was as follows: 40-week projected gestational weight gain = 2.0 + [27 × (delivery weight - prepregnancy weight - 2.0) ÷ (gestational age - 13)]. It was used in categories relative to the Institute of Medicine and Health Canada[9,14] recommendations (below, within, and above). In the deliveries in which women did not have gestational weight gain within the recommended range, the difference in the amount of weight gain needed to be within this range was calculated. Interpregnancy weight change was calculated as the prepregnancy weight in pregnancies in our time period (2003 to 2013) minus the prepregnancy weight in the previous pregnancy, even if the previous pregnancy occurred before 2003.

### Statistical analyses

Frequencies, proportions, and medians with interquartile

ranges (IQRs) were used to summarize the measures of pregnancy-related weight.

## RESULTS

There were 90 273 deliveries to Nova Scotian women aged 20 years and older from 2003 to 2013. In 63 355 pregnancies with both maternal height and prepregnancy weight recorded, the median (IQR) prepregnancy BMI was 24.7 kg/m$^2$ (21.7 to 29.4 kg/m$^2$). Fewer than half (48.5%) of the pregnancies were to normal-weight women, and nearly half were to women who were overweight (24.6%) or obese (23.0%) (**Table 1**). Of the women who entered pregnancy underweight, half would have needed to gain 2.0 kg or more to be within the normal-weight category (IQR = 0.9 to 3.8 kg). The median (IQR) weight loss required for women who entered pregnancy overweight or obese to be within the normal-weight category was 13.2 kg (5.7 to 25.2 kg).

In 54 289 singleton deliveries that had maternal prepregnancy BMI and delivery weight recorded, the median (IQR) gestational weight gain observed was 14.9 kg (11.0 to 19.1 kg), and the median gestational weight gain decreased as BMI category increased (**Table 2**). Approximately one-quarter (26.3%) of women gained weight within the recommended range. Excess gestational weight gain was prevalent (57.9%) and was most common among overweight women (72.8%).

**Table 1. Prepregnancy BMI among women in Nova Scotia, 2003-2013:** *N = 63 355.*

| BMI CATEGORY | PROPORTION |
|---|---|
| Underweight (< 18.5 kg/m$^2$) | 3.9 |
| Normal weight (18.5 to < 25.0 kg/m$^2$) | 48.5 |
| Overweight (25.0 to < 30.0 kg/m$^2$) | 24.6 |
| Obese (≥ 30.0 kg/m$^2$) | 23.0 |
| • Class I (30.0 to < 35.0 kg/m$^2$) | 12.6 |
| • Class II (35.0 to < 40.0 kg/m$^2$) | 6.3 |
| • Class III (≥ 40.0 kg/m$^2$) | 4.1 |

BMI—body mass index.

Gestational weight gain varied widely (**Figure 1**). Of the 15.8% of women with inadequate weight gain, half gained below the recommended amount by at least 2.2 kg. Of the women with excess weight gain, half gained above the recommended amount by at least 4.8 kg, and a quarter of women exceeded the recommended amount by 8.6 kg or more.

Among the 22 890 deliveries in which the mother's prepregnancy weight was recorded both for that pregnancy and her previous one, the median (IQR) interpregnancy weight change was 2.3 kg (-0.9 to 6.8 kg) over a median (IQR) interval of 2.1 years (1.3 to 3.6 years) (**Table 3**). Most (57.2%) women gained more than 1 kg between pregnancies, but one-quarter (24.6%) lost 1 kg or more of body weight between pregnancies. The proportion of women who lost more than 1 kg increased with prepregnancy BMI category, ranging from 11.1% in underweight women to 33.5% in women with obesity. Median interpregnancy weight gain increased with the time between pregnancies and was 1.4, 1.8, 3.2, and 4.5 kg with intervals of less than 2, 2 to less than 3, 3 to less than 5, and 5 or more years, respectively.

## DISCUSSION

Between 2003 and 2013, a high proportion of Nova Scotian women had pregnancy-related weight measurements in excess of recommendations. Many women (47.6%) entered pregnancy with a BMI of 25 kg/m$^2$ or greater, 57.9% had gestational weight gain in excess of recommended amounts, and 31.2% of women entered a subsequent pregnancy weighing at least 4.8 kg more than they had weighed at the start of their previous pregnancy. However, less prevalent, inadequate weight was also observed: 3.9% of women entered pregnancy underweight and 15.8% of women had gestational weight gain below recommended amounts.

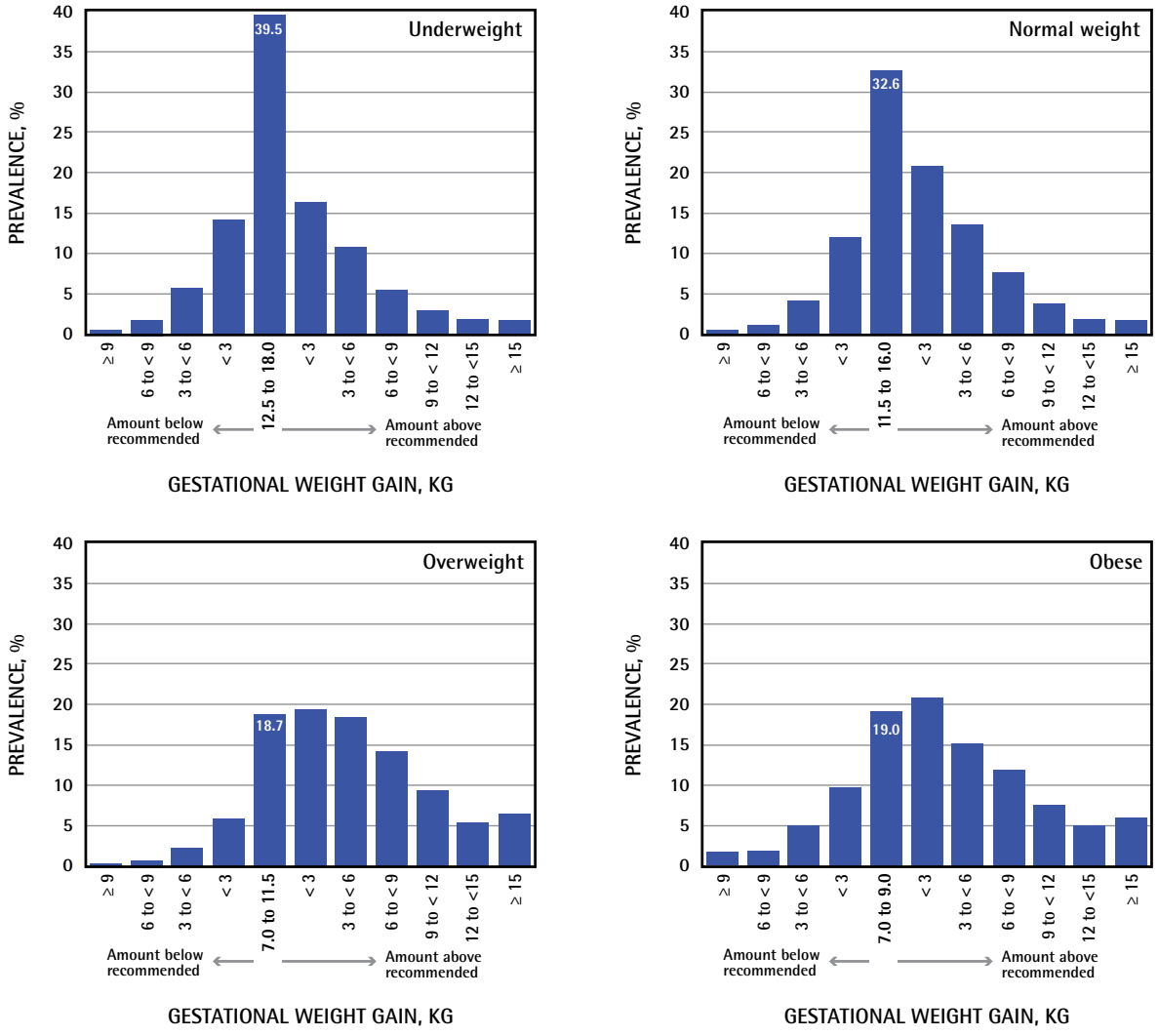
In this analysis, the prevalence of overweight or obesity (47.6%) was higher than was estimated among reproductive-aged women 20 to 39 years in the 2007 to 2009 Canadian Health Measures Survey (42.6%)[26] and in the Maternity Experiences Survey, a one-time national

**Table 2. Gestational weight gain in singleton pregnancies by prepregnancy BMI in Nova Scotia, 2003-2013:** *N = 54 289.*

| PREPREGNANCY BMI | N | MEDIAN (IQR) GESTATIONAL WEIGHT GAIN, KG | RELATIVE TO RECOMMENDATIONS, % | | |
|---|---|---|---|---|---|
| | | | BELOW | WITHIN | ABOVE |
| All women | 54 289 | 14.9 (11.0 to 19.1) | 15.8 | 26.3 | 57.9 |
| Underweight | 2118 | 16.2 (13.0 to 20.2) | 22.0 | 39.5 | 38.5 |
| Normal weight | 26 336 | 15.9 (12.7 to 19.7) | 17.9 | 32.6 | 49.6 |
| Overweight | 13 370 | 15.0 (11.2 to 19.5) | 8.4 | 18.7 | 72.8 |
| Obese | 12 465 | 11.2 (6.6 to 16.3) | 18.3 | 19.0 | 62.7 |

BMI—body mass index, IQR—interquartile range.

**Figure 1. Gestational weight gain by prepregnancy weight**




survey conducted in 2006 of women 6 months postpartum (34.5%).[27] These and other data sources suggest that the prevalence of excess prepregnancy weight is higher in the Atlantic provinces than in the rest of Canada.[18,19,21,27,28]

Reducing prepregnancy weight is warranted for many women, and SOGC guidelines suggest that periodic health examinations offer the opportunity to raise the issue of weight loss before conception.[13] The data presented here show that women who are overweight or obese would need to lose a substantial amount of weight to reach a BMI in the normal range. It should be emphasized, however, that the relationship between BMI and most adverse outcomes is continuous,[2-5] and even incremental advances toward an optimal BMI will have positive effects. In any case, prevention would be the most successful option and all young women should be supported to maintain a healthy weight and lifestyle.

Although it would be ideal for all women to enter pregnancy with BMIs in the normal range, the reality is that many will not, and surveillance data are useful for resource planning. The SOGC recommends that providers caring for women with obesity provide counseling about weight gain, nutrition, and food choices; advise about the increased risk of medical complications and congenital anomalies; shift fetal anatomic assessment to 20 to 22 weeks; consider antenatal consultation with an anesthesiologist; and consider thromboprophylaxis.[13] Increased rates of obesity-related obstetric complications and the need for staff training and specialized equipment also have implications for birth units.[29] The costs associated with obesity in pregnancy have not been evaluated in Canada, but US data demonstrate significantly higher service use and hospital length of stay among obese women ($P<.001$).[30]

**Table 3. Interpregnancy weight change by prepregnancy BMI in Nova Scotia, 2003-2013:** *N = 22 890.*

| PREPREGNANCY BMI | N | MEDIAN (IQR) INTERPREGNANCY WEIGHT CHANGE, KG | WEIGHT CHANGE, % | | | |
|---|---|---|---|---|---|---|
| | | | LOSS > 1 KG | STABLE WITHIN 1 KG | GAIN > 1 TO < 5 KG | GAIN ≥ 5 KG |
| All women | 22 890 | 2.3 (-0.9 to 6.8) | 24.6 | 18.2 | 26.0 | 31.2 |
| Underweight | 1020 | 2.7 (0.5 to 7.3) | 11.1 | 20.7 | 32.8 | 35.4 |
| Normal weight | 11 869 | 1.8 (-0.5 to 5.9) | 21.1 | 22.3 | 29.4 | 27.2 |
| Overweight | 5465 | 2.3 (-1.8 to 7.7) | 27.3 | 14.3 | 23.1 | 35.3 |
| Obese | 4537 | 2.3 (-3.6 to 8.6) | 33.5 | 11.5 | 18.9 | 36.0 |

BMI—body mass index, IQR—interquartile range.

Excess gestational weight gain is prevalent in Nova Scotia (57.9%), but inadequate gestational weight gain is also not uncommon (15.8%). Although estimates vary, inappropriate gestational weight gain is an issue throughout Canada.[18,27,31] Evidence suggests that many Canadian women are not familiar with the amount of weight they should gain in pregnancy[32,33] despite this information being available (eg, on the Health Canada website[34]). Health care providers report substantial barriers to broaching the issue of weight,[35] and whether newly developed tools such as the 5As of Healthy Pregnancy Weight Gain[36] can help to reduce these barriers and positively affect gestational weight gain is not yet known. As with prepregnancy BMI, the relationship between gestational weight gain and adverse outcomes is continuous, and any shift toward the optimal range will result in better outcomes.[37-39]

Estimates of postpartum weight retention and interpregnancy weight gain are not widely available. In a cohort enrolled in Alberta, a mean of 4.5 kg of body weight was retained at 10 to 12 weeks postpartum.[28] The general pattern suggests that weight remains elevated for 6 to 8 months postpartum before declining slightly until 12 months when it starts creeping steadily up again.[40] We have previously shown that gestational weight gain is associated with interpregnancy weight gain,[41] suggesting that interpregnancy weight change goes beyond age-related weight gain. Efforts to minimize interpregnancy weight gain should focus on both gestational weight gain and postpartum weight management.[14]

Further work is needed to find effective approaches tailored to this period and to identify characteristics of women at risk of pregnancy-related excess weight. Although work to date suggests that characteristics such as parity and ethnicity are associated with excessive gestational weight gain,[42] these associations are not strong enough to accurately identify women who are at risk. Until further research is done, the present study suggests that the prevalence of excess pregnancy-related weight is high enough to warrant body-weight monitoring in all women before conception, during pregnancy, and postpartum, providing counseling when needed. As the antenatal and postnatal period has been suggested to be a "teachable moment" in which women are particularly receptive to adopting healthful lifestyles,[43] interventions during this period should have the potential to substantially affect perinatal health and the future development of obesity and related chronic disease in women and their children.[10-12]

## Limitations

The prepregnancy weight measurements recorded on the Nova Scotia Prenatal Form are recalled by the mother or measured at the first prenatal visit, but these data are likely reasonably valid, as weight gain is slow in the first trimester[9] and self-report can be accurate in clinical situations in which women are being weighed.[44,45] Maternal height, prepregnancy weight, and delivery weight were missing in 19.4%, 17.7%, and 18.0% of pregnancy records, respectively. Complete interpregnancy weight gain data are dependent on both pregnancies occurring in Nova Scotia and having prepregnancy weight recorded; we had these data for 55.9% of pregnancies to multiparous women. However, we speculated that missing data were likely to be largely random due to a transition to a new version of the prenatal record in 2003 with a field for maternal height and the choice of some health care providers to not record height and weight. To confirm this assumption, we estimated values for women for whom these data were missing from other variables including weight measurements in other pregnancies and other maternal characteristics. The results using this multiple imputation technique were very similar to those presented herein, despite the common presumption that missing weight data in medical records is more common in heavier women. Primary strengths are that the study included women across Nova Scotia and provided information on interpregnancy weight change.

## Conclusion

Inadequate pregnancy-related weight was observed in some women in Nova Scotia but excess prepregnancy BMI and gestational weight gain were very prevalent, and the amount of excess weight could be quite large. Successful strategies are needed to promote healthier body weight in reproductive-aged women, optimize gestational weight gain, and support postpartum weight management.

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**Contributors**
**Dr Woolcott** conducted the data analysis and prepared the manuscript. All authors contributed to the concept of the study, the interpretation of the results, and the critical revision of the manuscript.

**Competing interests**
None declared

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