Timing of Excessive Weight Gain During Pregnancy Modulates Newborn Anthropometry

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Abstract

Objective: Excessive gestational weight gain (GWG) is associated with increased birth weight and neonatal adiposity. However, timing of excessive GWG may have a differential impact on birth outcomes. The objective of this study was to compare the effect of early and mid/late excessive GWG on newborn anthropometry in the context of the Canadian clinical recommendations that are specific for first trimester and for second/third trimesters based on maternal pre-pregnancy BMI.

Methods: We included 607 glucose-tolerant women in our main analyses, after excluding women who had less than the recommended total GWG. Maternal body weight was measured in early pregnancy, mid-pregnancy, and late pregnancy. Maternal and fetal clinical outcomes were collected, including newborn anthropometry. Women were divided into four groups according to the Canadian guidelines for GWG in the first and in the second/third trimesters: (1) "overall non-excessive" (reference group); (2) "early excessive GWG"; (3) "mid/late excessive GWG"; and (4) "overall excessive GWG." Differences in newborn anthropometry were tested across GWG categories.

Results: Women had a mean (±SD) pre-pregnancy BMI of 24.7 ± 5.2 kg/m^2 and total GWG of 15.3 ± 4.4 kg. Women with mid/late excessive GWG gave birth to heavier babies (gestational age-adjusted birth weight z-score 0.33 ± 0.91) compared with women in the reference group (0.00 ± 0.77, $P = 0.007$), whereas women with early excessive GWG gave birth to babies of similar weight (gestational age-adjusted z-score 0.01 ± 0.86) to the reference group (0.00 ± 0.77, $P = 0.84$). When we stratified our analyses and investigated women who gained within the recommendations for total GWG, mid/late excessive GWG specifically was associated with greater newborn size, similar to our main analyses.

Conclusion: Excessive GWG in mid/late pregnancy in women who did not gain weight excessively in early pregnancy is associated with increased birth size, even in those who gained within the Canadian recommendations for total GWG.

Key Words: Gestational weight gain, excessive, timing, newborn anthropometry

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Résumé

Objectif : Le gain pondéral gestationnel (GPG) excessif est associé à une hausse du poids de naissance et de l'adiposité néonatale. Cependant, le GPG excessif pourrait avoir des répercussions différentes sur les issues de naissance, en fonction de sa chronologie. Cette étude avait pour objectif de comparer, en ce qui concerne les paramètres anthropométriques du nouveau-né, l'effet de la présence d'un GPG excessif aux débuts de la grossesse à celui qu'exerce la présence d'un tel GPG pendant la partie médiane/tardive de celle-ci, dans le contexte des lignes directrices cliniques canadiennes (lesquelles formulent des recommandations particulières pour le premier trimestre et pour les deuxième / troisième trimestres, en fonction de l'IMC maternel prégrossesse).

Méthodes : Nous avons inclus 607 femmes tolérantes au glucose dans le cadre de nos analyses principales, après avoir exclu les femmes dont le GPG total avait été inférieur au GPG recommandé. Le poids corporel maternel a été mesuré aux débuts de la grossesse, au milieu de la grossesse et dans la dernière partie de la grossesse. Les issues cliniques maternelles et fœtales ont été consignées, y compris les paramètres anthropométriques du nouveau-né. Les

femmes ont été réparties en quatre groupes, conformément aux lignes directrices canadiennes pour le GPG pendant le premier trimestre et pendant les deuxième / troisième trimestres : (1) « GPG global non excessif » (groupe de référence); (2) « GPG excessif au premier trimestre »; (3) « GPG excessif aux deuxième / troisième trimestres »; et (4) « GPG global excessif ». Les différences en matière de paramètres anthropométriques du nouveau-né parmi ces catégories de GPG ont été analysées.

Résultats : Chez ces femmes, l'IMC prégrossesse moyen ($\pm\sigma$) était de 24,7 ± 5,2 kg/m^2 et le GPG total, de 15,3 ± 4,4 kg. Les femmes qui ont connu un GPG excessif aux deuxième / troisième trimestres ont donné naissance à des enfants plus lourds (score z du poids de naissance corrigé en fonction de l'âge gestationnel = 0,33 ± 0,91), par comparaison avec les femmes du groupe de référence (0,00 ± 0,77, P = 0,007), tandis que les femmes qui ont connu un GPG excessif au premier trimestre ont donné naissance à des enfants dont le poids était semblable (score z corrigé en fonction de l'âge gestationnel = 0,01 ± 0,86) à celui des enfants du groupe de référence (0,00 ± 0,77, P = 0,84). Lorsque nous avons stratifié nos analyses et que nous nous sommes penchés sur les femmes dont le GPG total se situait dans les limites prescrites par les recommandations, nous avons constaté que le GPG excessif aux deuxième / troisième trimestres était particulièrement associé à des dimensions néonatales accrues, soit un résultat semblable à celui que nous avons obtenu dans le cadre de nos analyses principales.

Conclusion : Chez les femmes qui n'ont pas connu un gain pondéral excessif aux débuts de la grossesse, la présence d'un GPG excessif aux deuxième / troisième trimestres a été associée à des dimensions néonatales accrues, et ce, même chez les femmes dont le GPG total se situait dans les limites prescrites par les recommandations canadiennes.

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INTRODUCTION

Accumulating evidence suggests that the intrauterine environment is implicated in the etiology of metabolic diseases over the life course, supporting the fetal programming hypothesis.[1,2] The intrauterine environment may be affected by numerous factors, maternal nutritional status being a major influence. Maternal gestational weight gain reflects, at least in part, maternal nutritional status and is a good marker of fetal nutrition.[3] Excessive GWG is common in Canada, affecting nearly 50% of pregnant women,[4] and has been associated with an increased risk of excessive birth weight and adiposity;[5–9] this in turn has been related to the risk of becoming overweight or obese later in life. Two recent meta-analyses estimated that high birth weight (> 4000 g) is associated with a two-fold increase in risk for overweight or obesity in the offspring.[10,11] Since increased size at birth likely tracks into childhood and adulthood, a better understanding of intrauterine factors influencing fetal growth is imperative.

Animal and human studies suggest that the effect of fetal nutrition on the health of offspring depends on the timing of variations during pregnancy and the organs and systems developing during that critical time period.[12,13] Excessive GWG may thus have different effects on short- and long-term outcomes in the offspring if occurring in early pregnancy, mid-pregnancy, or late pregnancy. Accordingly, Canadian guidelines for GWG,[14] which are based on the Institute of Medicine 2009 recommendations,[15] provide specific GWG guidelines (described in the "Methods" section) for first and for second/third trimesters according to pre-pregnancy maternal weight status to promote optimal maternal and birth outcomes.

Over the past few years, several cohort studies have examined the effects of the weekly rate of GWG during the first, second, and third trimesters of pregnancy on short-term[16–19] and long-term[17–23] anthropometric outcomes in the offspring. However, only one study has investigated newborn anthropometry in relation to Canadian cut-off values used clinically to examine the timing of excessive GWG; the investigators used week-specific weight gain limits recommended by the guidelines but did not define "early pregnancy" specifically as the first trimester.[24] We are not aware of any study that has examined the effects of trimester-specific excessive GWG on newborn anthropometry using the Institute of Medicine or Canadian recommendations for gestational week-specific cut-offs for the first and the second/third trimesters of pregnancy. Such studies are important to help guide clinical practice and to explore the validity of current GWG recommendations.

The objective of this study was to assess whether trimester-specific excessive GWG influences newborn anthropometry. We addressed this question using the Canadian recommendations for gestational week-specific cut-offs for the first and for the second/third trimesters (according to pre-pregnancy BMI) and by calculating trimester-specific weekly rates of GWG, considering that this is the most clinically relevant index for obstetric care providers. Indeed, the rate of GWG may be highly variable, and tracking the rate of GWG during pregnancy is the clinical information that clinicians use to counsel women in the hope of optimizing maternal and fetal health.[15] Gestational age-adjusted birth weight and length z-score and percentile, as well as newborn BMI, were used as primary outcome

ABBREVIATIONS

CHUS	Centre Hospitalier Universitaire de Sherbrooke
GDM	gestational diabetes
GWG	gestational weight gain