Article details: 2020-0276	
Title	Prevalence and risk factors for excess weight gain in pregnancy: a cross-sectional study using survey data
Authors	Jamie L. Benham MD PhD, Jane E. Booth MSc, Lois E. Donovan MD, Alexander A. Leung MD MPH, Ronald J. Sigal MD MPH, Doreen M. Rabi MD MSc
Reviewer 1	Dr. Helena Piccinini-Vallis
Institution	Dalhousie University, Halifax, NS
General comments (author response in bold)	Excess weight gain in pregnancy is an independent risk factor for a number of maternal and fetal outcomes. This study aimed to explore the proportion of Canadian women who experienced excess GWG from 2015 - 2018 and to identify risk factors for excess GWG. The following should be addressed: Line 24: The paragraph starting on line 24 is not quite correct. The 2009 IOM guidelines were updated to reflect the changing demographic of women entering pregnancy (higher BMI and older); it was the 1990 IOM guidelines that first introduced recommendations for GWG that were based on pre-pregnancy BMI. **Thank you for bringing this to our attention. We have corrected the paragraph to read as follows, "In 2009, the Institute of Medicine (IOM) updated the recommendations for gestational weight gain to reflect the changing demographic of women entering pregnancy including older women and women with more excess weight. These guidelines provide specific gestational weight gain recommendations for each BMI category. These recommendations were designed to reduce adverse maternal and neonatal outcomes associated with insufficient and excess gestational weight gain." (Page 3, Paragraph 2)** Line 50: was hypertension pre-existing or was this hypertensive disorder(s) of pregnancy? **Hypertension was pre-existing hypertension. Participants were not asked about hypertensive disorder(s) of pregnancy. As detailed in our response to the Editor's comments (please see above), we have removed this variable from our analysis.** Line 52: what is meant by "bowel disease"? **Bowel disorder included Crohn's disease, ulcerative colitis, irritable bowel syndrome, bowel incontinence or other. As detailed in our response to the Editor's comments (please see above), we have removed this variable from our analysis.** Line 52: Are the "behaviours during pregnancy" in this sentence referring to "smoking, alcohol and folic acid consumption"? If so perhaps this could be made a bit more clear by connecting the two sentences. **Thank you for this comment. To clarify the definition of behaviours during pregnancy, we have updated the sentence to read, "Behaviours during pregnancy including smoking, consuming alcohol and taking supplements containing folic acid were also evaluated as risk factors. These variables were coded dichotomously as any or no consumption during pregnancy." (Page 5, Paragraph 3).**

	Regarding the methods: an important variable that has not been mentioned is gestational age. Were the participants in the sample at term (i.e., at ≥ 37 weeks' gestation)? This is important because the IOM recommendations for total GWG over the pregnancy pertain to term pregnancies. Otherwise, excess GWG could be "missed" because not enough time was available for GWG. **Thank you for this insightful comment. While we agree this would be very valuable information, we unfortunately do not know the proportion of participants that gave birth at term. The question posed to participants in the CCHS questionnaire was "Have you given birth in the past 5 years?".** **To address this, we have added the following to the limitations section:** **"Another potential confounder that we were unable to evaluate was gestational age, as these data were not collected. Women who gave birth prior to term (i.e., <37 weeks gestational age) would have had less time to gain excess gestational weight, and the inclusion of these women would lead to underestimation of the proportion of women who gained excess weight during pregnancy." (Page 11, Paragraph 1)** The results of this study show that women with obesity had lower odds of gaining excess GWG compared to women with a normal pre-pregnancy BMI. Could the comparison be made between women with overweight and other pre-pregnancy BMI groups? Women with overweight are the ones who mostly tend to gain excess GWG. **Thank you for this suggestion. We have rerun the analysis so that women with overweight are the referent category and found the following:** **"Women with obesity had 33% lower odds of gaining excess weight compared to women with overweight (OR 0.67, 95%CI 0.48-0.94, p=0.022)." (Page 7, Paragraph 3)** Black and Indigenous women tend to gain excess GWG more than White women - however that comparison is not discussed in the results (page 37 line 47) even though those data were collected. **Thank you for pointing out this omission. We have added the following to the results section:** **"Women who identified as White had higher odds of excess gestational weight gain than women who did not identify as White (OR 1.38, 95%CI 1.17-1.64, p<0.001), as did women who identified as Indigenous compared with women who did not identify as Indigenous (OR 1.44, 95%CI 1.09-1.89, p=0.009). Women of South Asian, Chinese, Filipino, Arab, West Asian, Korean, Japanese or more than one ethnic origin had 36% lower odds of excess gestational weight gain than women who identified as White (OR 0.64, 95%CI 0.51-0.81, p<0.001)." (Page 8, Paragraph 2).** In this study, 31.6% of women had excess GWG. This number is lower than one typically sees in the literature. For example, McDonald et. al, (2018)* showed in a sample of Canadian women from 4 provinces that excess GWG happened in at least 49.9% of women and up to 65.6% of women, depending on the province. Their sample was from 2013 - 2014. Many other studies throughout the world also show higher rates of excess GWG. This discrepancy should specifically be mentioned in the results. However, I wonder if part of the discrepancy is due to the gestational age issue, as stated earlier in this review. Women who deliver at, for

	example, 32 weeks' gestation have not had the same amount of time to gain weight as women who deliver at 40 weeks' gestation. If prorated (using weekly recommendations) for gestational age, their GWG might have been excess, but this could have been missed if gestational age was not taken into account. This is an important point that was outlined in a recent publication.** **To address this, we have added the following to our discussion: "…studies that adjusted for gestational age have consistently reported a 10-15% higher frequency of excess gestational weight gain that those that did not such as the present study." (Page 9, Paragraph 2).** * McDonald SD, Woolcott C, Chapinal N, Guo Y, Murphy P, Dzakpasu S. Interprovincial variation in pre-pregnancy body mass index and gestational weight gain and their impact on neonatal birth weight with respect to small and large for gestational age. Can J Public Health. 2018;109(4):527-538 ** Champion ML, Harper LM. Gestational Weight Gain: Update on Outcomes and Interventions. Current Diabetes Reports. 2020 Mar;20(3):1-0.
Reviewer 2	Dr. Laura Forbes
Institution	
General comments (author response in bold)	In general, an important and clearly written paper on an important topic. Page 7 line 3 – any or no consumption for folic acid? Are you referring to supplements containing folic acid? Pretty much every woman would consume some folic acid in foods – it doesn't sound like you measured that. **Thank you for highlighting that this is not clear. We are referring to supplements containing folic acid. To clarify the definition, we have changed "folic acid consumption" to "taking supplements containing folic acid" (Page 6, Paragraph 1).** Table 1: Is information available on parity? I would love to know if there are differences in % excess wt. gain with the first vs. subsequent pregnancies – higher wt. gain in the first pregnancy is commonly reported in other studies. I'd also love to know if parity predicts excess weight gain – is it a better predictor than age? You mentioned in your discussion that parity wasn't measured. Thanks for mentioning that! You could include in your discussion that the difference by age may also be related to parity. **Unfortunately, parity was not measured. We have included the following in the Limitations section with respect to parity: "Several other risk factors for excess gestational weight gain have been identified in the literature such as lower self-efficacy, higher parity, lower physical activity during pregnancy and less healthcare provider advice that we were unable to evaluate because these questions not being administered in the CCHS." (Page 11, Paragraph 1)** Pg 10-11 This section about weight gain interventions seems a little off topic for this paper. **Thank you for this comment. As detailed in our response to the Editor's comments (please see above), while this study was not about interventions to improve appropriate weight gain in pregnancy, we believe the evidence for interventions to promote health weight gain is relevant.**

	I am most interested in what has changed between the Maternity Experiences Survey and this analysis. The results are very different – why is that? Perhaps it's new guidelines, perhaps it's increased counselling by health care providers. The results are especially different for overweight and obese women – its' striking. This raises a lot of questions. **Compared with the participants included in the 2006 Statistics Canada Maternity Experiences Survey, our sample had similar demographics. Our sample included fewer women with underweight (4% vs 6%) and normal weight (55% vs 59%) and more women with overweight (25% vs 21%) and obesity (16% vs 13.5%). Compared with the proportion of excess gestational weight gain reported by Kowal et al. from the Statistics Canada Maternity Experiences Survey, we found a similar proportion of women reporting a normal pre-conception BMI gained excess gestational weight (34% vs. 34.5%), while the proportion of women with underweight (37% vs 44.3%) and obesity (21% vs 27.7%) was lower, and increased in women with overweight (32% vs 26.8%).** **We have added the following to our discussion:** **"This may reflect improvements in counseling for pregnant women with obesity coinciding with the publication of several clinical practice guidelines within the last decade specifically address management of pregnancy in women with obesity including education regarding the risks associated with obesity and recommendations for gestational weight gain consistent with the 2009 IOM guidelines." (Page 9, Paragraph 2)** Are there differences by province? Alberta and BC have really made an effort to make changes to prenatal care around wt. gain – is there evidence that this has made a difference? **We have now included an analysis looking at gestational weight gain by province/territory. Compared with BC, there was no difference in the odds of gestational weight gain in any of the provinces or territories.** Could there be differences in reporting error between overweight, obese and normal weight women? **This is certainly a limitation, and have we have added the following to the Limitations section:** **"Weight and height were self-reported, potentially leading to misclassification, as women often underestimate their pre-conception BMI. This could result in an underestimation of the proportion of women who gained excess gestational weight secondary to participants being classified in a lower BMI category with a higher cut-off for gestational weight gain. Another consideration is that women with obesity have been found to underreport their gestational weight gain, which could further underestimate the proportion of excess gestational weight gain." (Page 11, Paragraph 1)** Have the demographics of the pregnant population changed over the past 10 years? **Compared with the participants included in the 2006 Statistics Canada Maternity Experiences Survey,[3] our sample had similar demographics.** Were there differences over time within the sample you collected? If you don't

	know the answers to these, it's okay, but I would like to see more discussion about the surprising differences seen and I would recommend suggesting future studies that could find out why there have been differences. **While we did not look at differences over time, there appears to have been a shift in which individuals develop excess weight gain in the last decade. We have discussed this in the interpretation section: "…while previous studies have generally indicated that obese women were more likely to gain excess gestational weight compared to those with normal BMI preconception, there has been a reversal in the association in the last decade, temporarily coinciding with the release of the IOM guidelines in 2009, and as was also confirmed by our findings." (Page 9, Paragraph 2)** **Recall bias is certainly a limitation in this study. A study on parental recall bias found no correlation between the delay in assessment and the validity of the estimate.[1]** Another note - APrON study measured weight gain in pregnancy in a similar time frame (2011-2012) as your participants. It's not a population-based sample, but they had a much high number is excess weight gain and overweight and obese women were at higher risk of excess gain. These were high education and high income women in Alberta – theoretically at lower risk of excess weight gain but had a much higher rate of excess gain compared to your sample. **This is an interesting point. Weight and height during pregnancy were measured in the APrON study, while the CCHS data reported self-reported weight, which could partially explain the differences seen. In addition, the women for the APrON study were recruited up to 26 weeks' gestation from 2009 to 2012 so it is possible that participants were not counselled during their pregnancies according to the updated 2009 guidelines.** **Comparing the participants in the APrON study to the CCHS sample we used, the proportion of women with normal BMI is lower in our sample (55% vs 64%), while the proportion of women with obesity is higher (16% vs 11%) as well as with overweight (25% vs 20%). The proportion of normal weight women who gained excess weight was 40% in their sample compared with 34% in the CCHS sample, so fairly consistent. The major discrepancy is in women with overweight and obesity.** Begum F, Colman I, McCargar LJ, Bell RC. Gestational weight gain and early postpartum weight retention in a prospective cohort of alberta women. Journal of obstetrics and gynaecology Canada : JOGC = Journal d'obstetrique et gynecologie du Canada : JOGC. 2012;34:637-647. Fatheema B Subhan 1 , Lisa Shulman 2 , Yan Yuan 3 , Linda J McCargar 1 , Linglong Kong 2 , Rhonda C Bell 1 , APrON Study Team and ENRICH. BMJ Open. 2019 Jul 27;9(7):e026908.doi: 10.1136/bmjopen-2018-026908. Association of pre-pregnancy BMI and gestational weight gain with fat mass distribution and accretion during pregnancy and early postpartum: a prospective study of Albertan women References: 1. Infante-Rivard C, Jacques L. Empirical study of parental recall bias. Am J Epidemiol. 2000;152:480-6. 2. Russell A, Gillespie S, Satya S, Gaudet LM. Assessing the accuracy of pregnant women in recalling pre-pregnancy weight and gestational weight gain. J

	Obstet Gynaecol Can. 2013;35:802-9. 3. Kowal C, Kuk J, Tamim H. Characteristics of weight gain in pregnancy among Canadian women. Matern Child Health J. 2012;16:668-76.