Author's response to reviews

Title: Magnitude of income-related disparities in adverse perinatal outcomes in Nova Scotia, 1988-2003

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Dead editors,

We thank the reviewers for noting that our article is scientifically and intellectually well-written, and that it helps readers to understand the complex relationship between socioeconomic position and perinatal health.

Both reviewers offered constructive comments for improving the article, and we respond to each concern below with details about how the manuscript has been revised (reviewer comments in italics).

Referee 1

1) A common theme in the public health is the examination of disparities in a particular health variable. This raises the question of how best to measure socioeconomic position. One approach is to use “direct” measures, such as income, expenditure or consumption. Another is to use a “proxy” measure, such as wealth indices. In this study, family income after tax and neighbourhood deprivation index were used to assess the socioeconomic position, so what are the limitations and potential problems of using these measures to clarify the socioeconomic position in this study?

Response: While we agree with the reviewer that there are multiple dimensions of SEP that could be measured in an analysis, one of the novelties of our approach was to not simply use one measure to assess SEP; but rather to compare the pattern of inequalities using a range of measures, including total family income (pre- and post-tax), income from investments, contribution to savings and an indicator of low-income. In turn, our findings enable readers to consider the possible role of different diverse pathways, such as the level of disposable income available for consuming health-producing goods (e.g., food), the accumulation of wealth and how this affects social mobility (e.g., through home ownership), and whether or not a family may be experiencing material deprivation and psychosocial marginalization associated with poverty. Thus, we have not mentioned our measurement of SEP at the family level as a limitation in the manner suggested by the reviewer.

We do recognize that SEP could manifest in different ways at the neighbourhood level, and that by only using a measure of material deprivation, we are not directly measuring other dimensions of SEP at the group level, including social capital, segregation and income inequality. We have included this idea as a limitation on page 14 of the Discussion section:

   Finally, while SEP may reflect a range of causal mechanisms at the group level in health research, including the level of material deprivation, income inequality, social capital and racial segregation (e.g., [38]), we only assessed the magnitude of inequalities relative to a measure of material deprivation in the neighbourhood in this study.

2) Neonatal death as key adverse perinatal outcome is highly associated with poor socioeconomic position. Why is not concerned in this analysis?

Response: Because neonatal mortality is such a rare outcome in this setting, we did not have enough cases to facilitate a stratified analysis of this specific outcome (even with the large sample size
included). Thus, we have analysed neonatal mortality with other perinatal deaths; and even then, the confidence intervals are quite wide for this pooled outcome.

Referee 2:

3) Page 3: In the conceptual framework when the authors mentioned “environmental level in relation to availability of prenatal care” that possible means the political context o the political determinants in which health care services are included. A more developed conceptual framework could help to understand the relationship between income and adverse perinatal outcomes.

Response: We have expanded our description of the conceptual framework for this analysis in what is now the second paragraph of the manuscript. The paragraph now reads:

Effects associated with SEP may reflect unique and inter-related mechanisms at multiple levels. This includes maternal and family characteristics associated with low income that mediate effects on adverse perinatal outcomes (e.g., whether or not a mother uses tobacco products during pregnancy), as well as macrosocial factors (i.e., economic, political and social) that are better measured at the group or environmental level (e.g., in relation to the availability of prenatal care) [8-18]. These mechanisms may also vary by other contextual factors. In particular, lower SEP can mean different things for families living in urban and rural settings [19]; for example, in Nova Scotia there is poorer access to specialized health services in rural setting [20]. Family composition may also change the implications of lower SEP since female-headed lone parent families are often young [21] and have low income [22, 23], which can make it harder to manage stressors than comparable two-parent families [24-29]. Identifying what dimensions of SEP mean at different levels and in different contexts can facilitate interventions [26]; yet, few studies have compared the consistency in associations across measures of SEP for perinatal outcomes, and across various contexts.

4) Alone mothers are considered vulnerable populations?

Response: We do not intend to generalize that all female-headed lone parent families are vulnerable. Yet, these families are lower in income in many cases because there is only one potential income-earner compared to potentially two; and there is also the fact of there being one parent to manage the household instead of two. Thus, in cases where parental demands are great and economic resources are limited, it will be relatively difficult for lone parent families to effectively “manage” ones family (e.g., child care, family support workers, social and health programs for children) without bearing significant and perceived stress compared to two parent counterparts. And, in fact, female-headed lone parent families in our analysis were more likely to be headed by a younger mother with lower income.

We have included some brief explanation about why we examine this subpopulation in the revised conceptual framework (underlined here for emphasis):
These mechanisms may also vary by other contextual factors. In particular, lower SEP can mean different things for families living in urban and rural settings [19]; for example, in Nova Scotia there is poorer access to specialized health services in rural setting [20]. Family composition may also change the implications of lower SEP since female-headed lone parent families are often young [21] and have low income [22, 23], which can make it harder to manage stressors than comparable two-parent families [24-29].

5) Page 3 and 4: the authors mentioned “We argue that risk factors such as environmental toxins should correctly be considered mediators of health effects related to income, rather than confounders” but it is not clear the relationship with SEP and adverse perinatal outcomes.

Response: We agree with the reviewer about the need to demonstrate why we would expect a relationship between “mediators” with SEP and adverse perinatal outcomes. We have revised the paragraph to include examples of how lower SEP Nova Scotians are more likely to be smokers and to live in more polluted environments:

For example, mothers of lower SEP are more likely to smoke tobacco products than higher SEP mothers in Nova Scotia [27], and some findings suggest that lower SEP mothers may also be more likely to continue smoking during pregnancy due to the the stressfulness of their context for several reasons (e.g., partly as a maladaptive coping habit [28]. Similarly, property values in Nova Scotia drive lower SEP families in Nova Scotia to live in more polluted environments [29, 30], so the deprivation level of a neighbourhood could reflect how likely individual are to be exposed to unhealthy environmental conditions [29, 30]. In these examples, family and neighbourhood SEP may increase risk for adverse perinatal outcomes through pathways involving differential exposure to tobacco smoke and air pollution; thus, we argue that such risk factors should correctly be considered mediators of health effects related to income, rather than confounders.

6) Some questions about methodology:

Design and study population is not described; Unit of analysis is not described

Response: We have included a sentence to specify the study design in the last paragraph of the Background (underlined here for emphasis):

“We examined the relationship between several indicators of SEP at the household and neighborhood levels and adverse perinatal outcomes among singleton births in Nova Scotia between 1988 and 2003 using a population-based observational study of the SEP in the year of delivery and birth outcomes up to one year of life.”

We have included a sentence to state the study population and to highlight the unit of analysis more explicitly in the first sentence of the Methods section:

The study population included all families (unit of analysis) that gave birth in Nova Scotia between 1988 and 2003.

7) Which reference curves are used to assign the percentiles of low weight for gestational age, include a reference
Response: We have already included a reference in the manuscript; #31:

Pediatrics 108: e35.

8) Mentioned the institution source of information. Who declare births in the register? It is exhaustive?

Response: When we introduce the Nova Scotia Atlee Perinatal Database in the Methods on page 5, we now explain more about how data is collected in the register and how reliable it is:

Data describing perinatal outcomes and maternal or household characteristics other than income were obtained from the Nova Scotia Atlee Perinatal Database (NSAPD), a registry that collects and compiles detailed maternal and perinatal health data for all births in the province by using trained personnel to extract information from antenatal and medical charts (as described elsewhere; [1]) in a reliable manner [31].

9) Which is the T1 Family File?

Response: We have included more information to describe the T1 Family File at the bottom of page 5:

A partnership with Statistics Canada facilitated a confidential linkage with income tax-related information for the year in which delivery occurred using the T1 Family File [33]. The T1 Family File includes parent(s) and children living at the same address, but not persons living at the same address who are not in the family, including approximately 95% of all Canadians. The File aggregates income-related information from a variety of data received by the Canada Revenue Agency, including from all individuals who filed a tax return or who received a Canada Child Tax Benefit, children who filed a tax return and who reported the same address as their parent(s), as well as children and spouses who did not file their own tax return, but whose wage and salary information are available from other sources.

10) Identify which are the dependent variables? Which are the independent variables?

Response: We have revised the Methods on pages 5 through 7 to include sub-headers and other language to explicitly describe the dependent and independent variables used in the study.

11) More information about excluded cases is required e.g. if there were information about income and not about adverse perinatal outcome, the missing cases were distributed in all groups of income?

Response: There were small differences in family income and neighbourhood deprivation levels between families included and excluded from the analysis due to missing data for LGA, SGA, and preterm birth outcomes (There were no missing values for perinatal and postneonatal death outcomes). Families excluded from the analysis due to missing data were more likely to be in lower family income strata and less likely to be in upper family income strata - and were less likely to reside in neighbourhoods with lower deprivation - than those included in the analysis. For all outcomes, the difference in income and deprivation composition within strata was less than 7%, and
usually less than 4% (data not shown). Since it is impossible to know the birth outcome status of these individuals, it is not possible to predict the direction of bias; however, given the small size of these differences, any impact on the magnitudes reported here are likely to be minimal.

We have included a more concise version of this explanation in the Discussion section on page 14 (underlined here for emphasis):

There were limitations of our data and approach. First, not all birth records were linked to data on the income variables; linkage was successful in 81.3% of records [43]. Thus, the extent to which the failure to link may have contributed to an over or underestimate of the associations is not known. Also, some families were missing data on SGA (2%), LGA (2%) and preterm birth outcomes (iatrogenic, 5%; spontaneous 4%). Families excluded from the analysis here were less likely to be of higher SEP or to reside in lower deprivation neighbourhoods (For all outcomes, the difference in income and deprivation composition within strata was less than 7%, and usually less than 4%; data not shown.) It is not possible to predict the direction of bias; however, given the small size of these differences, any impact on the magnitudes reported here are likely to be minimal.

12) In the discussion the authors assume that the readers know the Canadian health care system. Explain about universal coverages of health care services in order to discuss implications for other countries.

Response: We have included a new paragraph on page 14 of the Discussion to address cross-national comparisons/generalizability:

These findings are from a Canadian setting with single payer universal health coverage for all essential healthcare services, so we expect there to be some generalizability for other settings with universal coverage like the United Kingdom. Whereas in other settings like the United States, where the quality of antenatal care is commensurate with the level of family income, we might expect income to be a stronger predictor of perinatal outcomes, and so we might expect inequalities to be of an even larger magnitude.

13) Yes but in table and figures labelled if the percentile 25 are the best or the worse in order to better interpret the tables and figures

Response: We agree that this change would make the results clearer for the reader, so we have revised Table 2 and all Figures to include this information.