Author's response to reviews

Title: Development of a Canadian Socioeconomic Status Index for Environmental Health

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Author's response to reviews: see over
Reviewer 1: Jamie Seabrook

Comment 1: In this study, the authors developed a Canadian SES Index for environmental health. The paper is well written and the statistical analyses are appropriate. The authors also raise an important point that single indicators of SES are unlikely to reflect its complexity. The major limitation of the paper is its lack of novelty. The association between SES and adverse birth outcomes has been well documented, and even with the development of the SES index, the findings are pretty much exactly what one would have suspected. Why not use the SES index as a predictor of a health outcome where findings have been mixed or at least less consistent? The authors need to be clear why this study is important, especially with regards to studying a very well documented association between SES and adverse birth outcomes.

Response 1: Indeed, the association between SES and adverse birth outcomes has been well documented in literature and we acknowledge this. However, the purpose of utilizing adverse birth outcomes in our research was for validation purposes of our SES index only and we were not trying to establish new associations or contribute to a relationship that was already been well documented. We considered using a known association as suitable to assess the predictive value of our index.

Comment 2: The Background in the abstract is one line and does not convey what the study is about.

Response 2: A sentence has been added in the Background, which describes the lack of a comprehensive SES in Canada (line 25).

Comment 3: There is no objective in the abstract. I needed to read the text before the abstract made sense.

Response 3: A sentence was added about the objective in the abstract (line 26).

Comment 4: Be consistent throughout the paper with in the spelling of “socioeconomic”.

Response 4: This has been noted and the spelling is now consistent. We modified it nine times.

Comment 5: Spell out the abbreviation of PM$_{2.5}$ in the abstract. Most readers will not know that this refers to particulate matter.

Response 5: This has been noted and the abbreviation is now spelled out. Please see line 36.
Reviewer 2: Anne Peasey

This was an interesting paper, that set out to develop a more sensitive measure of SES than the indices currently used in Canada, while at the same time building of the previous work. The development of the index was thorough, however I have a number of comments, some relating to the validation of the index, which I have set out below. Since there are a number of major revisions being requested, these need to be addressed before a decision on published can be reached.

Major Compulsory Revisions:

Comment 1: The word ‘health’ or the rough equivalent is used in many places throughout the manuscript but this terminology needs to be defined more succinctly. For example, in the title it is environmental health (line 1), in the abstract it is children’s health (line 23) and then later pregnancy outcomes, then line 72 refers again to child health, line 87 is more general and says health outcomes and in line 143 “birth outcomes. I would recommend changing most of these to health, and then for the validation sections of text state “birth outcomes” because at present the focus is unclear.

Response 1: We changed the wording to “health outcomes related to environmental pollution” in order to be more precise. The title of the manuscript has also been changed. Please see: lines 27, 91, 93, 109, 129, 237, 243.

Comment 2: Line 72: what is the project on mapping environmental factors and child health? While I am sure the authors are familiar with the context of the paper, the reader will not be familiar. The start of this paragraph should be reworded. I would suggest deleting lines 72 and 73, and beginning the paragraph with “Environmental stressors such as …”.

Response 2: This has been noted. We deleted lines 72 and 73.

Comment 3: Line 87-91: reword the lines “We provide an example of how to develop an SES index …. We created a novel index …” These sentences should set out what the paper plans to do, not summarise what the paper achieves – that should be in discussion and/or conclusions e.g. line 226 onwards.

Response 3: The tense has been changed with lines 91-94.

Comment 4: Line 143-150: unless I have misunderstood there is a fundamental flaw in the time line or temporality in this paper. The authors are attempting to validate the new
index by examining the association between birth outcomes in the period 1999-2008 and the SES index from 2006. While some of the births will have occurred after the 2006 census, most of the births are likely to pre-date the census data, and some by as much as 7 years. This would seem to make it impossible to use this outcome data to validate the index by, as the authors state, examining “the well-researched concept that low SES may be related to adverse birth outcomes” (line 144-145). A correct validation would require the authors to limit the analysis to data on singletons from 2006-2008, or find a more recent set of pregnancy outcomes, or alternatively use a previous census to construct the SES index. Or have the authors assumed that these SES measures have been fairly static over the period, and so assessment of the association is valid with the data presented? Is there evidence to support this? There is no mention in the discussion of these critical assumptions nor the evidence. This point must be appropriately addressed before the paper can be considered for publication.

Response 4: Because the association between SES and adverse birth outcomes is well established, we assumed that temporality was not an issue when examining the validity of our index. This assumption was further evidenced by relationships seen in our study with both the Chan and Pampalon index and adverse birth outcomes (despite temporality), which is reflected in past research. Additionally, power is increased from increased cases in statistical analyses by including more years of data. Lastly, we assume that our index assumes stability over time, serving as a proxy in population based studies using data from other years. Please see lines 308-311 for further discussion.

Comment 5: Line 152: add detail concerning the statistical methods / tests used to assess the association between SES index and concentration of particulate matter.

Response 5: A line has been added about the statistical tests used in the assessment (please see line 158).

Comment 6: Line 152: here, as in point 4, it is not clear what came first, the SES data or the particulate concentrations. Is it appropriate to look at the association between these two if there is up to 7 years separating the data?

Response 6: Comparing our SES index and the Pampalon index to particulate concentrations was for validation purposes only, and not for exploring new relationships against this known association. Both indices utilized data from the Census 2006 and we assumed stability of SES over time. Thus, temporality is not assumed to be an issue with this exercise.
Comment 7: Line 160: please modify this section so that it describes the statistical method / test used to compare the association between the new SES and the Pampalon index, and the outcomes of interest. Current it only describes the variables in the Pampalon index.

Response 7: The statistical methods are now incorporated into the paragraph (please see lines 166-167). We utilized Spearman correlation and t-tests to compare the associations between our SES index and that of Pampalon’s with adverse birth outcomes.

Comment 8: Line 229-231: it is stated “it is novel in that we …” but there was no mention in the results section of the contribution of “age of homes” nor the importance of “cultural identities”. The manuscript returns to same topic in lines 236-247. The authors must add results to support these statements to the results section, and then discuss in the Discussion.

Response 8: Specific to the results section, line 185 contained information related to cultural identities. A line was added about the lack of aboriginal status in line 186 and a sentence was added in line 187 in relation to age of the home.

The importance and justification of incorporating a cultural identity section for our SES index was stated in detail in the Methods section (lines 111-120). Additionally, the importance of utilizing the age of the home as a proxy for environmental pollution was stated in detail in the Methods section (lines 129-133). Although we attempted to explore the relationship between age of the home and SES, we did not find an association (lines 246-257), which may be unique to Canada. Moreover, only medium sum HDI groups and not aboriginal groups participated in the PCA and were consequently incorporated into the SES index, which may also only be unique to Canada (lines 259-288). Thus, these novel inclusions of age of the home and aboriginal identities may not be as prominent as initially hypothesized.

Comment 9: Line 231-234: while it is adequately argued by the authors that a single scale such as the new Index proposed here could be beneficial, it is important to also present the downside i.e. the potential shortcomings of the index and also of the paper in general. This is lacking from the paper at present and should be added. For example, while for the purposes of mapping pollution, SES and health a single index could be useful, for the purposes of public health policy and intervention, the Pampalon index would enable independent consideration of social and material deprivation.

Response 9: You are right. Since a separate limitations section was not permitted in the manuscript, as per BMC guidelines, we added sentences indicating potential limitations to our study. These included not having the option of using a social or material index (Pampalon index) and the assumption of the stability of the index over time (please see lines 303 and 308).
**Comment 10:** Line 249: “Cultural differences were strongly evident with our SES index” – please add results to support this statement to the results section.

**Response 10:** Cultural differences (specifically medium sum HDI groups) were associated with our SES index (please see line 185). However, there was not an association between our SES index and aboriginal status (please see line 186).

**Comment 11:** Line 285 and other places in the manuscript where there is reference to comparing the association between the new Index and adverse birth outcomes, and the Pampalon index and adverse birth outcomes – as discussed above in point 4, there is potentially a major flaw in using singleton data from before the 2006 census to compare the performance of the two indexes.

**Response 11:** Comparing our index with Pampalon’s index to adverse birth outcomes was for validation purposes only, and not for creating new associations for known relationships. Thus, temporality is assumed to not be an issue with this exercise. Additionally, we assume that our index and Pampalon’s index are stable with time.

**Comment 12:** There is no section on the limitations of the paper. This section must be added to the discussion.

**Response 12:** Please see added limitations in lines 303 and 308. Unfortunately, the journal does not allow for a separate limitations section.
Minor Essential Revisions:

Comment 1: Line 30: make it clear that time period for birth outcomes is 1999-2008 and PM2.5 exposures during pregnancy.

Response 1: The time period for adverse birth outcomes and PM 2.5 exposures was listed in line 37.

Comment 2: Line 34: make clear that normal at country level not DA level

Response 2: This has been noted.

Comment 3: Line 58-62: Reword slightly “….. using Census 2006 data. [ 7] Four deprivation criteria: residential instability, material deprivation, dependency and ethnic concentration were defined and inequalities in 18 health and behavioural problems from the Canadian Community Health Survey (CCHS) reported.[7]“

Response 3: Sentence was reworded.


Response 4: Pampalon estimated mortality rates from negative binomial regression using deaths in 2001 and the reference population from the census of the same year.

Comment 5: Line 100: replace “We investigated these data for all of Canada’s dissemination areas …” with “These data cover all of Canada’s dissemination areas …”

Response 5: Line was replaced.

Comment 6: Line 105: “A set of 22 variables FROM THE 2006 CENSUS was selected …”

Response 6: This was added.

Comment 7: Line 271: Replace “Another consideration …” with “Another explanation…”

Response 7: This was changed.
Comment 8: Line 283-284: correct the grammar. Change “and” for “with”
Response 8: This was changed.

Comment 9: Line 456: Please state the data source for these variables
Response 9: “Census 2006” was added.

Comment 10: Figure 1: The provinces needs to be explained eg footnote.
Response 10: Full explanation of provincial abbreviations included.

Comment 11: Figure 1: The zero is missing from the y-axis label for 0.00
Response 11: The zero was included in the y-axis with a line drawn through the middle of the figure for clarity.

Comment 12: Figure 1: Change y-axis to 1 decimal place
Response 12: This was changed.

Comment 13: Figure 2-5: maybe present on a single page these 4 figures.
Response 13: Figures 2-5 were incorporated into one figure (Figure 2).

Comment 14: Add descriptive table of general characteristics of singleton births and all birth outcomes in Edmonton
Response 14: This table was added.

Comment 15: Supplement 1 to 4: add footnote for all Canadian provinces.
Response 15: Additional information on abbreviations for Canadian provinces and territories are now included.
**Discretionary Revisions** These are recommendations for improvement which the author can choose to ignore. For example clarifications, data that would be useful but not essential.

**Comment 1:** Line 55: maybe you could refer to more recent deprivation indices such as IMD2010  
**Response 1:** This was incorporated into the manuscript.

**Comment 2:** Line 64: change the word “utilization” for “value”  
**Response 2:** This was changed.

**Comment 3:** Line 67-70: it is not clear which index is referred to when you say “This index only included …”. Please reword. “The Pampalon index only included …”  
**Response 3:** This was reworded.

**Comment 4:** Lines 87-91 – some of this text is really well written, instead of being deleted this text could be moved to the conclusion (line 297)  
**Response 4:** Please refer to comment and response 3 in “Major Compulsory Revisions” section.

**Comment 5:** Lines 300-303: this is a quite narrow conclusion. If properly validated, then this new index has the potential to enable a better assessment of SES inequalities in a variety of health outcomes in Canada at DA level, including those in environmental health.  
**Response 5:** This was added to the conclusion section (lines 320-321).