Author's response to reviews

Title: Associations between neighbourhood environmental characteristics and obesity and related behaviours among adult New Zealanders

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Author's response to reviews: see over
Dear Rita Aguirre,

Thank you very much for the opportunity to upgrade various aspects of this manuscript. We responded to your editorial comment and those by the reviewers, point by point, in the text below. Please note that Reviewer #1 requested that the unadjusted model results be removed from the tables and the text within the Results section. For now, we have left the results in the Tables but no longer include a description of these results in the text. Perhaps you could advise us of the journal’s preference on this matter and we will respond accordingly. As requested, we re-coded the access to greenspace variable, for consistency with other environmental access measures. As such, results in tables have been modified. We also include a caption below relevant tables for clarity on the access ranking schemes used. Changes in the manuscript are included as red text.

Editor's comment:
Please state in the manuscript whether the data used for their study is openly available or whether you received permission (and by who) to use this.

Our response: We now include an Acknowledgements section which states, “Access to the data used in this study was provided by Statistics New Zealand under conditions designed to give effect to the security and confidentiality provisions of the Statistics Act of 1975. The results presented in this study are the work of the authors, not Statistics New Zealand.”

Reviewer 1 Comments:
The objective of this study is to examine environmental factors associated with overweight, obesity, and weight-related behaviours in New Zealand, adjusting for individual-level covariates. The authors analyze data from the 2006/7 New Zealand Health Survey, as well as geographic information that was linked to individual-level information at the census area unit level.
Overall, I am positive about this paper. It is well written, and addresses a timely topic that would be of interest to the readership of BMC Public Health. However, there are several issues that the authors need to address, as outlined below.

Major Compulsory Revisions
1. This is more of a question/comment than a revision per se. The first issue that the authors should provide comment on is related to the methodology chosen. Given the hierarchical structure of the data, I wonder about the rationale for using logistic regression models over multilevel models that seem to be more apt for this type of analysis.

Our response: This is a very good question. Our data are indeed hierarchical (survey participants are units within neighborhoods) and thus, we could have described the health outcomes for an individual as a sum of effects for the individual and the individual’s neighbourhood or region in order to draw inference for the population means at different levels.
However, because our research intent was to make inference about the entire New Zealand population about potential associations between environmental characteristics and individuals, we opted to specify the complex survey sampling structure in our regression analyses. Specifically, in all analyses, we used sample weights to adjust for the complex multi-level sampling design of the health survey and to ensure that estimates are representative of the target population. These weights account for the geographic clusters used in sampling, as well as the oversampling of Māori, Pacific and Asian populations and the low response of some groups (e.g. young males).

**Minor Essential Revisions**

2. The introduction does a good job of reviewing the relevant literature on GIS-based measures of environmental variables, however, there is no discussion of the important individual-level covariates of overweight/obesity, or the other environmental influences (e.g. deprivation). These do, however, appear in the methods section of the paper, which also outlines the Sallis et al framework. These should appear within the introduction section alongside the other literature reviewed, rather than the methods section.

**Our response:** In the Introduction, we have now included some of the individual-level risk factors for obesity and linked those direct factors with the neighbourhood environment. We have also added a brief discussion of the international evidence related to neighbourhood deprivation and greenspace.

3. Though Table 2 provides a summary of demographic characteristics at the individual level, there should also be some summary of the ecological variables beyond the description provided in Table 1. For example, what is the average distance to nearest food outlet within each quintile? This information would be helpful to the reader.

**Our response:** We now include a column with descriptive statistics for each variable in Table 1 (minimum, 25\textsuperscript{th} percentile, mean, median, 75\textsuperscript{th} percentile and maximum).

4. Results section, paragraph 3. The authors state that "The lowest level of access to greenspace was significantly associated with decreased odds of being overweight." However, the model (Table 4) shows the opposite. This appears to be merely an error in the wording of the sentence.

**Our response:** You are correct. In Table 4 greenspace shows an adjusted OR of 0.74 for overweight status. So, the highest level of greenspace access (higher value as originally written) was significantly associated with decreased odds of overweight. This was corrected in the text.

Additionally, we have altered the scale for greenspace access to be consistent with the access to food outlets and sports/leisure facilities as requested below.
5. It is somewhat confusing that two of the measures of accessibility (i.e. food outlets, sports/leisure facilities) are constructed by decreasing access (1=best, 5 = worst), while the measure of access to greenspace is the opposite (1=worst, 5 = best). All 3 measures should be in the same 'direction' for consistency.

*Our response:* Agreed. We have now altered the ordering of the greenspace quintiles to be consistent with the other measures. As such, we have updated the regression results in Tables 3-6, and the relevant text related to these regression model results.

**Discretionary Revisions**

6. The inclusion of unadjusted results does not appear to contribute to the paper in any meaningful way, beyond showing the evolution of the models from unadjusted to fully-adjusted. Though their inclusion does not detract from the paper, the authors might consider removing these, or the discussion of the unadjusted regressions in the results section, and focusing solely on discussion of the adjusted models

*Our response:* We opted to leave these results in the tables, but now do not discuss the unadjusted results in the text. Perhaps the Editor can advise on the journal’s preference.

**Reviewer 2 Comments:**

**Major Compulsory Revisions**

I am going to classify these as minor because I believe the authors WILL address these in an accepted manuscript.

1. I think it is key, in the abstract as well as in the body of the work, that the authors compare their results to findings in other parts of the world.

*Our response:* We now include a more thorough discussion of the international literature in the Introduction and compare our findings to international studies in the Discussion, while still meeting word limits. We also revised the abstract to highlight the general consistency between our study findings and those in other studies.

2. It would be useful to know the population level in each of the census divisions used in the work (meshblock and CAU).

*Our response:* We now include the average population size for each of these geographic units in the Methods section.

3. One of the findings indicates a significant negative relationship between low levels of walking and neighbourhood deprivation. What role does CRIME play in
this relationship? Did the authors explore crime, real or perceived?

**Our response:** This is an important point you have highlighted. We did not directly explore this in our current research (due to limitations in variable selection as a requirement for maintaining confidentiality by the Ministry of Health). However, we have conducted other research on both recorded and perceived crime in New Zealand. Thus, we have amended the Discussion section to state, “Other New Zealand research has shown that other factors are correlated with neighbourhood deprivation which may affect walking behaviours, including both recorded and perceived crime [35]. The fear of neighbourhood crime has also exhibited a negative impact on mental and physical wellbeing in New Zealand [36], and has been shown to reduce residents’ walking within the local neighbourhood in Australia [37] and the UK [38]. Future research may further untangle the causal mechanisms in our identified association between overweight and obesity and walking behaviours and neighbourhood deprivation status by including neighbourhood crime measures.”

4. It appears that all food outlets (i.e., grocery stores, fast food, etc) were lumped together. IF this is the case, why and what impact is this having on the results?

**Our response:** It is correct that both grocery stores and fast food outlets were aggregated. This was largely due to the limitations in variable selection as a requirement for maintaining confidentiality by the Ministry of Health. This could impact our results and we now include a discussion of this consideration, as follows, “Also, we were limited by the number of environmental variables permitted by the Ministry of Health. As a result, some relevant neighbourhood characteristics (e.g. crime rates) were not included and others were aggregated (e.g. foodshops included both grocery and fast food as one variable) in these analyses. The aggregation of types of food outlets limited our ability to separately assess the potential positive influence of access to stores offering healthy food options from the potential negative influence of access to unhealthy food options and therefore may be the reason for our largely null findings for this neighbourhood variable.”

5. Does accessibility to sports/leisure facilities include biking/hiking trails?

**Our response:** No, this variable does not include these types of recreational facilities. We have tried to emphasise this in the description in Table 1.

**Final comments:** We thank the editor and the reviewers for thoughtful comments that have helped us to further improve the manuscript through clarification and justification.