Author’s response to reviews

Title: Association between the food and physical activity environment, obesity, and cardiovascular health across Maine counties

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[NOTE: All line numbers refer to the line numbers in the tracked changes version of the manuscript (see Supplemental manuscript with tracked changes).]

REVIEWER 2 COMMENTS

The author has addressed all the comments, responding appropriately to all suggested changes from minor typos, to detail additions, to changing of wording for whole sections to improve clarity. They have explained their reasoning behind decisions and responded sufficiently to ensure the manuscript makes a sound contribution.

Thank you for your review and feedback. We appreciated the opportunity to re-submit and we believe that these changes have strengthened the manuscript.

REVIEWER 3 COMMENTS

The revised manuscript seems to have addressed a number of the reviewers’ concerns, but some important comments need further consideration in the paper (see list below). In addition, I would like to raise the following:
1. An important issue relates to how the clustered nature of the data (participants nested within counties) does not appear to be taken into consideration in the modelling. Please adjust models accordingly or provide strong rationale for not doing so.

Thank you for this note. We deliberately chose to conduct an individual-level analysis using BRFSS data with county environment context provided by the USDA food environment variables. Our goal was to isolate the potential relationship between the built environment on health outcomes in this analysis in order to explore potential contributors to these relationships. While we understand that a variety of components may contribute to individual-level health patterns seen in the data, multilevel modelling can introduce assumptions that may not be true and can bring unanticipated confounding to the models, so we chose not to use this approach in our analyses.

2. Please clarify in the methods section of the abstract the type of built environment attributes that were examined.

Thank you for your suggestion. We have specified the types of built environment attributes that were examined in the abstract (Page 2, Lines 28 - 30), which we believe adds further clarity for the reader.

3. Please add ME to list of acronyms and abbreviations in relevant tables (not clear for Non American readers)

Thank you for this suggestion. We have added ME to the list of abbreviations below all relevant tables and in the table of acronyms for the paper.

4. The following statement “Individuals living in counties with high densities of both fast food restaurants, full-service restaurants were more likely to have poor diet, be obese, and have poor CVH” is inconsistent with the type of analyses reported in table 2 (chi-square and not direct comparison between tertiles or trends analysis). Please revise accordingly

Thank you for identifying this issue. We have updated to use the wording “higher proportion” instead of “more likely” in the results section (Pages 10-11, Lines 221-233) to clarify the trend that we can conclude from these statistics.

Below are my comments on the original reviewers’ comments that need further attention:
1. Line 278: It may actually be a marker for increased density of the urban environment and therefore associated with increased physical activity.

Thank you for this insightful idea. We found this suggestion quite compelling, but we would like to focus the discussion of our paper on the nuanced impact of the environment within rural areas. Additionally, increased population density may not always predict better health outcomes. For instance, Ahern et al. (2010) investigated the impact of fast-food restaurants in metro and non-metro counties separately. They found that high density of fast-food restaurants was positively associated with obesity and diabetes in metro areas, but negatively associated with these outcomes in nonmetro areas.

I agree that population density is a potential confounder and this needs to be addressed, the same way that area-level SES does (see below).

Thank you for this comment. We assessed the relationship between population density and each food environment variables when building the models. In these assessments, we found that population density was strongly correlated with the food environment variables (correlation coefficients above 0.4) and thus does not belong in the same models. Our goal in this analysis was to not over-adjust in the models in order to isolate the relationships between each food environment variable and key health indicators, after adjusting for individual characteristics. We have noted the limitations of the scope of this analysis in the limitations section (Page 16, Lines 330-334), and we suggest that future work builds upon this analysis to examine the multiple complex environmental components that can contribute to health indicators.

2. Line 490: Models should be adjusted for country level income.

We have adjusted for personal income in the models, which adjusts for the income of each BRFSS respondent included in the model when predicting each health outcome. Our goal was to assess the impact of each environment characteristic on health outcomes, after adjusting for individual demographic characteristics. According to this framework, we adjusted for the income of each individual respondent rather than adjusting for county income overall.

This is an important point that needs to be properly addressed by the authors. This could be part of a sensitivity analysis for instance. Area-level SES is clearly a potential confounder in these kind of relationships and needs consideration.

Thank you for this suggestion. We agree that income is clearly a strong driver of health outcomes, as shown in our descriptive analyses. We have adjusted for personal income in the models, which adjusts for the income of each BRFSS respondent included in the model when predicting each health outcome. We deliberately did not include county median income in the models, however, because this variable is strongly colinear with personal income and thus cannot
be included within our models, which already adjust for personal income. However, as you suggest, we do isolate county median income as an environmental variable of interest, which demonstrates how county median income may impact health outcomes after adjusting for individual-level characteristics (including personal income).

3. Line 74: explain how the environment influences diet and physical activity in positive and negative ways.

We have clarified that the environment can influence health behaviors and health outcomes in both positive and negative ways in this sentence (now Line 104, page 4). For brevity, we have not expanded further upon this point in the introduction, but we do elaborate on the positive and negative influences of the environment when we discuss our findings in the results and discussion sections.

Line 74-76: What did these studies find?

We have clarified that these studies have demonstrated both positive and negative influences of the built environment in Line 79, page 4. We have also highlighted the unexpected, varied findings from one rural study of food environments in order to demonstrate the mixed results of recent food environment studies. We have not further elaborated the findings of each of these studies individually for the sake of brevity, as another reviewer suggested that we limit this section to no more than 2 pages. We agree this strengthens this section.

I agree with the reviewer’s comment that this particular sentence lacks clarity. What do you mean by positive and negative ways? Does it mean that the direction of the relationship depends on whether the environmental characteristics is healthful or not? If you mean mixed findings, then use this terminology instead.

Thank you for the question. Per your recommendation, we have updated to explain that prior studies have yielded mixed findings (Page 4, Lines 76-77), which we agree more specifically addresses the variation in prior research.

4. Line 101: Provide statistics to evidence the poor CVH in Maine.

Thank you for this suggestion. We have provided evidence of poor CVH in Maine earlier in the introduction section, in Line 61, page 3.

It would not hurt to repeat the same citation as reference supporting the statement.

Thank you for this suggestion. We have repeated the same citation as a reference to support this statement (Page 5, Line 103).
5. Line 129: Provide evidence of the validity of the BRFSS data given it is based on self-report. We have already noted this evidence in the Limitations section of the manuscript, but have also cited a meta-analysis to provide evidence of the validity of BRFSS in the Methods section (Line 123, page 6).

I cannot find a clear statement on the evidence of the validity of the BRFSS (most of the line numbers provided don’t seem to match the pdf version)

Our apologies, the line numbers changed after uploading the manuscript to the Editorial Manager system and we were unable to make adaptations at this stage in the process. We cited a meta-analysis that demonstrates the validity of BRFSS in the Methods section (Page 5, Lines 113-114).

6. There is very little information provided on the results for PA or diet. Why is this?

Thank you for this inquiry. We have included descriptive results for physical inactivity and poor diet in Table 1 and Table 2 and have described these results within these results sections. We focused specifically on CVH indicator variables (poor CVH score, obesity) rather than lifestyle behaviors (physical inactivity, poor diet) in our multivariable models since these outcomes are the intermediate health factors that often result from lifestyle behaviors and in turn contribute to poor CVH outcomes.

Line 172: It is a bit confusing as to whether physical activity and diet were examined separately or not. Some sections of the text suggest they were, but this sentence suggests that they were just examined as part of the CVH score. This needs to be adjusted and made much clearer for readers throughout.

Thank you for this comment. In response to your question, physical activity and diet were descriptively analyzed separately, but were not included as outcomes in our multivariable models. We have clarified that we descriptively analyzed poor diet and physical inactivity in our Methods section (Line 152, Page 7 and Line 186, Page 9). We have also noted that we only conducted multivariable models for key CVH indicators of interest, and we did not fit models for health behaviors (Line 197 and Line 202, pages 8-9). We did not fit models for health behaviors due to space constraints. Our goal was to focus on the more pressing CVH issues of obesity and overall poor CVH (since health behaviors contribute to these more macro-level outcomes).

The current manuscript still states that “18 separate multivariable logistic regression models, one for each combination of key CVH indicator of interest (obesity, diabetes, and poor CVH score) and food and physical activity environment variable (6 total).” (lines 165-167), which seems to be contradicting the authors response and is inconsistent with the results reported. This needs to
be clarified and the text edited for consistency across all sections. The number of tests (18) also raises some issues around multiple testing, which is not acknowledged in the paper.

Thank you for the question. As we noted in the response above, we only included CVH indicators as outcomes in our models (obesity, poor CVH score, and diabetes). However, as we noted, we did not present model results for diabetes due to insignificant results and low sample sizes that reduced statistical stability. For clarity, we have updated the manuscript to describe only our models for poor CVH and obesity (12 models total) in the methods (Page 8, starting in Line 172) and results (Page 11, starting in Line 235) sections. We have also added the limitation of multiple testing and isolating each of these characteristics (Page 16, Lines 352-356) in order to clarify this limitation for the reader and suggest potential avenues for future work. Thank you for this suggestion, and we believe that this strengthens the manuscript.