PEER REVIEW HISTORY

ARTICLE DETAILS

TITLE (PROVISIONAL)	Impact of Neighbourhood Walkability on the Onset of Multimorbidity: A Cohort Study
AUTHORS	Moin, John; Glazier, Richard; Kuluski, Kerry; Kiss, Alex; Upshur, Ross

VERSION 1 – REVIEW

REVIEWER	Rizwan Shahid Alberta Health Services, Primary Health Care
REVIEW RETURNED	22-Jan-2021

GENERAL COMMENTS	The authors performed a cohort study on the impact of neighborhood walkability on the onset of multimorbidity. The paper is well written and presented. I do not have any major concerns. Few suggestions are: Canadian Dollar should be written as CAD instead of CND. Explain what is The On-Marg Index in the beginning of the section. Readers should not wait until page 11 to know it is Ontario Marginalization Index. Add a map showing the area (the City of Toronto and 14 neighborhoods within Ontario used in this study. Besides these comments, I do not have any problem with the manuscript proceeding to publication.

REVIEWER	Jocelyn Bowden The University of Sydney, Institute of Bone and Joint Research
REVIEW RETURNED	24-Jan-2021

GENERAL COMMENTS	Dear Study Authors Thank you for the opportunity to read your protocol manuscript. You have undertaken a retrospective cohort study with a time to event analysis to examine the relationship between risk of multimorbidity and the walkability of neighbourhoods. This is an important area of research and it is great to see more work in this area. My comments mostly related to readability and clarification of a few points. 1. ON-Marg index (page 9) – could you also put what this is an index of in the section title. E.g. an SES index, etc. 2. In a few sections you have put a study showed… but not clarified the condition or group of conditions. For example, material deprivation was strongly associated with multimorbidity in a previous study -Could you please note it here it was for chronic conditions etc (or other). Similarly the walkability index and its relationship reduced dependence on cars. Was this a general cohort?

	3. Please spell out the ICES acronym in full at first use, or at least in the Methods section. 4. Age groups: Please make the reporting of your age groups consistent. The abstract only mentions 20-64, but your statistical analysis and other section mentions stratification by the two age brackets. Please make the abstract consistent with the main text as you have reported to 95 in your results. 5. Also page 15 line 33, can you please add here you have run the stratified by analysis by age grouping (or other), as a reminder to the reader. 6. Results: I was getting very confused with the different quintiles as I read (walkability and deprivation), especially as the scales are reversed (Q1= least deprived but also least walkable). I know you have tried to explain it clearly, but could you give them a different acronym or similar so its really obvious to a lay reader what you are discussing (especially in the Discussion)? 7. Results (p16 line 37), are the deprived levels here correct? Isn't Q1 the least deprived? 8. Discussion: Opening sentence: Is this across all ages or just for <65? 9. Discussion: Out of interest - were you able to look at any of the specific chronic diseases as subgroups? For example musculoskeletal conditions (especially in the lower limb) are often linked to walkability and have a huge impact on other chronic conditions such as CVD, diabetes etc. Were you able to look at or infer anything from your results. 10. Page 22, line 44. I think you mean from, rather than form here. 11. Please check your reference formats. 12. Figures: I really like the figure in Appendix 5 (although it is not noted in the main text). It makes your results much easier to visualise and interpret than the list of numbers in the table. Could you put this in the main text as well as the similar figure for the older age groups? 13. A flow diagram of all included participants and your age grouping would also assist. 14. You may not have space, but a couple of sentences on the general layout and SES etc of Ontario would be useful to give some an international context to your findings.

VERSION 1 – AUTHOR RESPONSE

Reviewer: 1
Dr. Rizwan Shahid, Alberta Health Services, University of Calgary
Comments to the Author:
The authors performed a cohort study on the impact of neighborhood walkability on the onset of

multimorbidity. The paper is well written and presented. I do not have any major concerns. Few suggestions are:

We are thankful for your review and kind words regarding the draft manuscript.

Canadian Dollar should be written as CAD instead of CND.

We thank the reviewer for picking up our typo. The typo has been corrected. (p. 4)

Explain what is The On-Marg Index in the beginning of the section. Readers should not wait until page 11 to know it is Ontario Marginalization Index.

Thank you for this helpful suggestion. The description for the ON-Marg has been moved up in the methods section. (p. 6)

Add a map showing the area (the City of Toronto and 14 neighborhoods within Ontario used in this study.

The following is the geographic coverage of the Walkability Index within Ontario, Canada.

Besides these comments, I do not have any problem with the manuscript proceeding to publication.

We are grateful for your helpful suggestions.

Reviewer: 2
Dr. Jocelyn Bowden, The University of Sydney

Comments to the Author:
Dear Study Authors

Thank you for the opportunity to read your protocol manuscript. You have undertaken a retrospective cohort study with a time to event analysis to examine the relationship between risk of multimorbidity and the walkability of neighbourhoods. This is an important area of research and it is great to see more work in this area. My comments mostly related to readability and clarification of a few points.

We are grateful for your review and for your appreciation of this study and the need for more research within context of multimorbidity and impact of the built environment on physical activity promotion and population health.

1. ON-Marg index (page 9) – could you also put what this is an index of in the section title. E.g. an SES index, etc.

Please see the On-Marg title where the following has been added: '(Area-Level Measure for Socioeconomic Status and Marginalization)' . (p.6)

2. In a few sections you have put a study showed… but not clarified the condition or group of conditions. For example, material deprivation was strongly associated with

multimorbidity in a previous study -Could you please note it here it was for chronic conditions etc (or other). Similarly the walkability index and its relationship reduced dependence on cars. Was this a general cohort?

With regards to your first comment, in a cross-sectional study, material deprivation was shown to be highly associated with multimorbidity (derived from the same list of chronic conditions as this study). Furthermore, there was a positive association shown between each deprivation quintile and increased prevalence of multimorbidity within the entire population of Ontario.

1. Moin JS, Moineddin R, Upshur REG. Measuring the association between marginalization and multimorbidity in Ontario, Canada: A cross-sectional study. J Comorb. 2018;8(1):2235042X18814939.

With regards to your second comment, at least two studies that I am aware of, have shown that in general, populations that reside within more walkable neighbourhoods are less dependant on cars, showing less automobiles per household and higher average use of other modes of transportation (walking, cycling, public transit). Both studies were conducted within Southern Ontario.

1. Chiu M, Shah BR, Maclagan LC, Rezai MR, Austin PC, Tu JV. Walk Score® and the prevalence of utilitarian walking and obesity among Ontario adults: A cross-sectional study. Health Rep. 2015;26(7):3-10.

2. Creatore MI, Glazier RH, Moineddin R, Fazli GS, Johns A, Gozdyra P, et al. Association of Neighborhood Walkability With Change in Overweight, Obesity, and Diabetes. JAMA. 2016;315(20):2211-20.

3. Please spell out the ICES acronym in full at first use, or at least in the Methods section.

ICES was previously known as the Institute for Clinical Evaluative Sciences. A few years ago, they dropped the title and retained the acronym. Therefore, ICES is now their official name.

4. Age groups: Please make the reporting of your age groups consistent. The abstract only mentions 20-64, but your statistical analysis and other section mentions stratification by the two age brackets. Please make the abstract consistent with the main text as you have reported to 95 in your results.

Thank you for pointing this out. It is an excellent suggestion and we have corrected the manuscript accordingly. Please see pages 2 and 3. (p. 2, 3)

5. Also page 15 line 33, can you please add here you have run the stratified by analysis by age grouping (or other), as a reminder to the reader.

The 2 age cohorts have been documented now on page 2, 10, 13, and 16. I also made a minor change on page 15 to clarify which results pertain to which cohort.

6. Results: I was getting very confused with the different quintiles as I read (walkability and deprivation), especially as the scales are reversed (Q1= least deprived but also least walkable). I know you have tried to explain it clearly, but could you give them a different acronym or similar so its really obvious to a lay reader what you are discussing (especially in the Discussion)?

Thank you for pointing this out. Unfortunately, this can be a bit confusing at times, as walkability in Q5 neighbourhoods is a good thing while Q5 deprivation is not. To help keep this in perspective for the readers unfamiliar with these indexes, I have added within brackets, brief definitions of each. Please see pages: 10.

7. Results (p16 line 37), are the deprived levels here correct? Isn't Q1 the least deprived?

Thank you for double checking, yes they are. It is not clear why Q1 would not be significant while Q2 is. But we have seen this happen in other studies and indices where the associated outcome was stronger in Q2 than Q1 or Q4 rather than Q5. It could be due to the fact that Q1 which would include the poorest population qualify for government assistance and programs, while Q2 represents the lower-middle class, which at this point in time is experiencing

difficulty and stress associated with higher costs of living and little to no assistance from the government. While this may be the explanation, we did not want to speculate in this study. Therefore, there is no clear justification for this phenomenon at this time, but we hope to examine this further in subsequent studies.

8. Discussion: Opening sentence: Is this across all ages or just for <65?

You are correct, this was a bit confusing. Results were only significant within the younger cohort, which is what we expected. I have explicitly mentioned the 20-64-year cohort at the beginning of the discussion to make this clearer.

9. Discussion: Out of interest - were you able to look at any of the specific chronic diseases as subgroups? For example musculoskeletal conditions (especially in the lower limb) are often linked to walkability and have a huge impact on other chronic conditions such as CVD, diabetes etc. Were you able to look at or infer anything from your results.

This is an excellent point and something that we hope to investigate in future studies to see which morbidities tend to be more restrictive in terms of mobility or whether there is a subset of chronic conditions that are best remediated by physical activity. However, for this study, given that the initial cohort were healthy adults without multimorbidity and the novelty of examining the relationship between the built environment and multimorbidity, the sub-analysis of individual or subset conditions were out of scope with this study.

10. Page 22, line 44. I think you mean from, rather than form here.

Thank you for catching this mistake. Please see correction. (p. 21)

11. Please check your reference formats.

References have been checked in accordance with current Vancouver style reference guidelines.

12. Figures: I really like the figure in Appendix 5 (although it is not noted in the main text). It makes your results much easier to visualise and interpret than the list of numbers in the table. Could you put this in the main text as well as the similar figure for the older age groups?

This is a good point, however there was no significant results for older age groups, therefore we did not include figure for older age group. The forest plot for the younger cohort (20-64) has been moved to the results section. Please see page 16.

13. A flow diagram of all included participants and your age grouping would also assist.

This is an excellent suggestion, however due to COVID19 restrictions I do not have access to the data sets to generate numbers for the flow diagram.

14. You may not have space, but a couple of sentences on the general layout and SES etc of Ontario would be useful to give some an international context to your findings.

This is a great suggestion, unfortunately I am finding it difficult to include contextual information about the current economic state within Ontario, Canada, as it breaks the logical flow of the manuscript tying together record low physical activity, ensuing risk for chronic diseases and the need to identify new creative methods for increasing physical activity in the population. While there have been other studies highlighting the need for socioeconomic interventions, this study highlights interventions targeting the built environment as a means to promoting greater physical activity. To answer you directly in case you were interested; the socioeconomic experience of most Ontarians has been similar to many other developed counties. Beyond the growing gap between the rich and poor, incomes have not kept pace with the price of living since the late 80s. Income stagnation has been a problem in Ontario; the lowest three quintiles of income distribution gained little between 1990 and 2010. The middle-income bracket saw an average rise of 10% over this time, while the top income bracket saw a gain of nearly 30% (1). Compounding trends of income stagnation for most households, is that Ontarians also carry high debt loads. In the last 3 decades there has been rising debt levels, low interest rates and over-reliance on consumer credit to compensate for rising costs of living (1). The average family in 1990 held debt equal to 93% of disposable income, while in 2010 that figure was 150% (1). Therefore, with exception of the top income quintile, Ontarians have seen little to no increase in wages to compensate for growing debt, education, living, and housing costs. These studies highlight some of the ongoing financial hardships and challenges facing many Ontarians. Unfortunately, income is an important determinant and low income associated with multimorbidity (2, 3).

VERSION 2 – REVIEW

REVIEWER	Jocelyn Bowden The University of Sydney, Institute of Bone and Joint Research
REVIEW RETURNED	06-Apr-2021

GENERAL COMMENTS	Thank you for your changes - and the Quartiles are now much clearer! No further comments.

REVIEWER	Rizwan Shahid Alberta Health Services, Primary Health Care
REVIEW RETURNED	06-Apr-2021

GENERAL COMMENTS	The authors have addressed all comments. I do not have any other concerns.