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Title	Female gender and food insecurity in relation to mental health struggles in Canadian adults: a cross sectional study using survey data
Authors	Catherine M. Pounda MD MSc(C), Yue Chen MD PhD
Reviewer 1	Dr. Hsing-yi Chang
Institution	National Health Research Institutes, Center for Health Policy Research and Development
General comments and author response	1. Authors mentioned 18 questions on food insecure were used. But those 18 questions were different from what was used by FAO. How were the answers to 18 questions classified into 3 categories? The variable used in our study – Household food security status – modified version (FSCDVHFS) is adopted from the Health Canada model of food security status levels published by Health Canada in 2007. As per the CCHS 2015-2016 Derived Variable Guide, this variable (FSCDVHFS) "is based on a set of 18 questions and describes the food security situation of the household in the previous 12 months. It captures three kinds of situations: 1- Food secure: No, or one, indication of difficulty with income-related food access. 2- Moderately food insecure: Indication of compromise in quality and/or quantity of food consumed. 3- Severely food insecure: Indication of reduced food intake and disrupted eating patterns. For more information about this model, please see The Office of Nutrition Policy and Promotion, Health Canada, "Canadian Community Health Survey, Cycle 2.2, Nutrition (2004)-Income-Related Household Food Security in Canada". The following clarification was added to the paragraph on 'Combined exposure of food insecurity and gender' in the Methods section of the manuscript and a new reference was added (22) The household food security variable in the CCHS was based on a set of 18 questions that described the food security situation of each household in the previous 12 months (18): food secure, moderately insecure, and severely insecure. This definition was adopted by CCHS from the Health Canada model of food security status levels published by Health Canada in 2007 (22). 22. Government of Canada. Canadian Community Health Survey, Cycle 2.2, Nutrition (2004): Income-Related Household Food Security. https://www.canada.ca/en/health-canada/services/food-nutrition/food-nutrition-surveillance/health-nutrition-surveys/canadian-community-health-survey-cchs/canadian-community-health-survey-cycle-2-2-nutrition-2004-income-related-household-food-security-canada-health-canada-2007.html (accessed Aug. 31, 2020)
Reviewer 2	Dr. Hasanain Ghazi
Institution	Management and science University, Community Medicine
General comments and author response	1. better to choose another word than Synergism in the title The title has been changed as per the Senior Editor's suggestion to the following: "Female gender and food insecurity in relation to mental health struggles in Canadian adults: a cross sectional study using survey data." 2. introduction too short A hypothesis was added to the introduction 3. why no ethical approval? what about approval to use the data? Ethics approval was not needed as this data is publicly available. 4. discussion missing The discussion is labeled 'Interpretation' 5. why put aboriginal in the limitation? We included the fact that Aboriginal individuals living on reserve are not sampled in the CCHS as a limitation. Since they are not sampled in the CCHS, we have no information as to their food security status as well as mental health difficulties, yet they are part of the Canadian population. Studies also show that Aboriginal individuals are at high risk for both food insecurity and mental health difficulties. If they were included in our sample, they may

	supply data that could show important associations between gender, food insecurity and mental health difficulties
Reviewer 3	Dr. Richard Lewanczuk
Institution	University of Alberta, Endocrinology
General comments and author response	1. In the last line of the abstract as well as the conclusion, I would suggest further explanation, as an important point of the paper is the call to action, given the findings. Specifically, I think it is overly simplistic to say that we need to develop methods to address mental health issues in the specific population. Rather, it should be highlighted that there must first be awareness and screening. Anything that can be done preventatively around mental health issues in the population should be put in place, and for those who already have these issues, then appropriate treatment should be offered. However, as the authors indicate, a proportion of the population cannot be screening by primary care due to lack of attachment. Thus, innovative screening methods (e.g. at the food bank, or by social services) may also need to be considered. Don't need to add a lot – just an additional sentence or two in the conclusion. Thank you for this comment. We added the following to the conclusion of the manuscript. There is therefore an urgent need to continue raising awareness with regards to the prevalence of mental health illnesses in food insecure individuals. Heightened consideration should be given to the development of innovative and far-reaching screening methods, as well as the implementation of strategies to support the mental health of food insecure individuals, specifically targeting middle-aged women, in light of their heightened risk of poor mental health outcomes in relation to food insecurity. 2. I agree that self-perceived mental health is the desirable measure and I would recommend the authors be a little less apologetic about this in the Methods and Limitations. In person-centered care, it is the individual experience that is important. Given the lack of primary care continuity, as the authors point out, mental health issues may be undiagnosed in a subset of the food insecure cohort. However, more importantly, even if there is primary care access, screening may not occur within the primary care practice. Thank you also for this comment, and wholeheartedly agree with you. We have not made any changes to the manuscript as we felt it was important to address this point as some people, including one of this manuscript's reviewers, considered it a significant limitation. We would be happy to revisit if the reviewer thinks the wording should be changed. 3. It may be worthwhile for the authors to comment on the inter-correlations or superimposition of chronic illness (including mental) and the wide variety of social determinants as well as available social supports which often inversely correlate with need (e.g. food deserts are more common in lower SES areas, lack of access to transportation as a contributor to food insecurity). While we very much agree with this reviewer's comments that chronic illness and a multitude of social determinants of health impact food insecurity, we elected not to address this particular comment as the focus on our manuscript is on the synergistic impact of female gender and food insecurity in association with mental health struggles. We would be happy to revisit if the reviewer feels strongly that this discussion should be included in the manuscript 4. The sentence in line 51 is incomplete. The sentence was corrected. It now reads: One Canadian study reported a prevalence of mental illness of 35% in individuals with food insufficiency (12), in contrast to an approximate 10% prevalence in the general Canadian population (13). 5. At first I found Table 1 confusing. I would suggest an explanation of what the p values represent in the table description or as an Asterix explanation Table 1 has been modified to show that the p-values apply to the prevalence of perceived mental health struggles associated with food security, gender and covariates

	6. Only for thought: it is interesting that older age mitigates the mental health impact. The same is found for loneliness or social isolation and mental health. I totally agree with the authors that age, social determinants effects and interactions are an area for research. Thank you for that comment
Reviewer 4	Imaan Bayoumi
Institution	Queen's University, Family Medicine
General comments and author response	1. The introduction states that women are at increased risk of poor mental health in relation to FI. How are the research objectives distinct from this previously reported result? What is the unique contribution of this paper? The unique contribution of this paper is that it underlines that the joint effect of gender (being a women) and food insecurity, is actually larger than the effect that each of these exposures would have on food insecurity individually; women are at higher risk of mental health struggles, food insecurity is also a risk factor for mental health struggles, but when both of these risk factors are present together, the association is larger than what would be expected by just adding up the two risk factors. This is explained in the second paragraph of the Interpretation section of the manuscript, but has also now been clarified in the conclusion of the paper. We have added the following clarification to the conclusion: It also emphasizes the synergistic effect of female gender and food insecurity resulting in an excess risk of mental health difficulties, especially in the 40-64 year age group. 2. Perceived mental health- The authors use perceived mental health difficulties as the outcome measure and argue that diagnosed mental illness may underestimate the prevalence of mental illness due to barriers to accessing primary care. However, arguably, this measure risks overestimating mental illness, as many people who experience MH struggles may fall short of the threshold for diagnosing Mental illness. Thank you for this comment. While we agree that using perceived mental health difficulties may overestimate mental health illnesses, mental health issues are known to be underdiagnosed in the general population, even in people who have access to primary care. As pointed out by another reviewer, the individual's experience is at the heart of person-centered care, and the association between gender, food insecurity, and self-reported mental health struggles highlights the need to pay particular attention to this subgroup of the population. We added the following sentence, and a new reference, to the Limitations section of the manuscript to emphasize that mental health disorders are underdiagnosed in Canada. First, mental health disorders are known to be underdiagnosed in Canada (26). 26. Pelletier L, O'Donnell S, Dykxhoorn J, McRae L, Patten SB. Under-diagnosis of mood disorders in Canada. Epidemiol Psychiatr Sci. 2017; 26:414-423. 3. The wording of the question would help to clarify the outcome measure for the reader. It is also important to report the time frame captured in the question. This has been addressed under the subsection 'Measurement of mental health struggles' in the Methods section of the manuscript. The paragraph now reads: Five levels of self-reported perceived mental health states (poor, fair, good, very good, and excellent) are collected by the CCHS in response to the question: In general, would you say your mental health is… excellent/very good/good/fair/poor/don't know/refusal/not stated (18). Individuals with mental health struggles were those who reported poor or fair mental health. 4. Food insecurity - the authors should define how they categorized presence and severity of food insecurity. There is literature on the negative health outcomes associated with even mild food insecurity, which may also be meaningful to examine in this study. Please see the response to question 6 asked by Senior editor for definition of the food insecurity variable. Although we agree that it would have been interesting to look at mild food insecurity, this was not captured by the CCHS 2015-2016 data 5. Why do the authors use listwise deletion of covariates with missing values, as opposed

	to multiple imputation? Multiple imputation would outperform listwise deletion for data MCAR (missing completely at random) and MAR (missing at random). Missing data in our study are believed to be MNAR (missing not at random), and both multiple imputation and listwise deletion would yield biased results. A recent simulation study found that multiple imputation actually yields results that are frequently more biased, less efficient, and with worse coverage than listwise deletion when data are MNAR. Please refer to the following article for more specific details. Pepinsky TB. A Note on Listwise Deletion versus Multiple Imputation. Political analysis. 2018; 26: 480-488. 6. It would be helpful to describe the cohort more fully, particularly the older age group. How does each age category break down by gender, FI status and MH difficulties? Does this differ for the older age group (one imagines it may). How might demographic differences in age groups aid in interpretation of results? A supplementary table has been added with this information (Supplementary table 1). We had difficulties for further breaking down subpopulations due to relatively small efficient sample size (when taking the complex survey design into consideration). 7. The discussion is thin. More discussion is required for interpretation of the results and to discuss the implications of the findings. At minimum, this should include a discussion around directionality and more discussion to contextualize the results with previous literature. Do the authors think FI leads to MH struggles or that MH struggles lead to FI (ie perhaps those with MH difficulties struggles are more likely to be disabled, consequently be unable to work and have lower income +/- receive social assistance which may lead to FI. For the older age group, what do the authors think the role of CPP, OAS and GIS may be? This is the only age group who effectively have a Guaranteed Annual Income in Canada, which likely buffers them from severe FI at least to some extent. Please refer to question 12 of the Senior Editor. More information has been added to the discussion. The prevalence of food insecurity is indeed lower in the older age group. However, the prevalence of perceived mental health struggles in males in the severe food insecurity group is no different from the prevalence of mental health struggles in the other age groups, as shown in Table 2 and Supplementary Table 1. While we agree that CPP, OAS and GIS may potentially protect against food insecurity to a certain extent in that age group, it does not seem to impact the relationship between food insecurity and perceived mental health struggles. 8. Minor point - first reference Tarasuk is misspelled. Thank you for catching that. It has been corrected
Reviewer 5	Dr. Andrew Bulloch
Institution	University of Calgary, Community Health Sciences
General comments and author response	1. What is the overall proportion of respondents reporting poor/fair mental health in the CCHS 2015-2016? In the full CCHS 2015-2016 dataset, 7% In our study population, 6.7%. This can be obtained from table 1 (4107 cases/61,446 participants) 2. RERI, AP and the Synergy Index are the correct metrics to use, but will not be familiar to many readers of this journal. Please add brief descriptions of each and explain why you chose to use all 3 of them. All three metrics measure additive interaction, but examine the size of the interaction from different angles. Definitions were added to the Statistical Section of the manuscript. RERI measures the proportion of increased risk of mental health struggles due to the interaction of female gender and food insecurity relative to the risk without exposure to either factor, AP measures the proportion of mental health struggles due to the interaction of both factors, and the S-index measures the excess risk from the interaction relative to

	the excess risk anticipated without an interaction (sum of individual effects). 3. The description of Table 1 is incomplete, please describe results from Age down We elected not to describe the whole table in the text of the manuscript, as the information can easily be found in the table, therefore avoiding duplication. If the reviewer feels strongly about this though we would be happy to re-evaluate. 4. Re Table 3 I would argue that significance is nearly obtained for the 18-39 group, the lower CI (0.97) for the point estimate is close to 1.00. Also requiring all 3 metrics to be significant seems a little harsh to me. While we agree that significant is nearly obtained for the 18 to 39 year old age group, our main message is that there is a significant additive interaction between severe food insecurity and female gender, and that this interaction is more pronounced for the middle age adults. 5. I like Fig 1 but could not see a reference to it or a description. A reference has been added to the last paragraph of the results section