Food For Thought: A Secondary Analysis of Food Security Status, Mental Health Status, and Self-Perceived Stress in Canadian Households

Chris Ayala Angumba[redacted]

Stephanie Boissonneaul[redacted]

Olivia Wing Yee Chow[redacted]

Tina Farokhifar[redacted]

Wesley Mai[redacted]

Sabrina Yuen[redacted]

Faculty of Community Services, Toronto Metropolitan University

FNR310: Senior Quantitative Research Project

Dr. Sharon Wong

December 9, 2022

Key words: household food security, mental health, mental well-being, Canadian Community Health Survey, stress

Abstract

Background: The link between food insecurity and mental health has been investigated and well established within the literature; however, this association has never been examined in the Canadian context during the timeframe of the CCHS Cycle 2.2. Investigation into this topic can help guide future interventions. **Research Objective:** Investigating the association between food insecurity status and mental health and well-being in Canada. **Research Methods:** We conducted descriptive and inferential statistics using the independent variables "household food security status," "food situation in household," "worried food would run out - 12 mo.," and "could not afford to eat balanced meals - 12 mo." and the dependent variables "self-rated mental" and "self perceived stress" drawn from CCHS Cycle 2.2 2004-2005. We ran cross-tab analyses, Chi square, Pearson correlation, and Bivariate linear regression tests between each of the variables. We conducted nine multiple linear regression models for each of the dependent variables and evaluated their F statistic, R^2, and standardized Beta coefficients. **Results:** All Pearson correlations resulted in statistically significant weak correlations ($r = < +/- 0.20$, $p<0.001$). All independent variables similarly explained the variability in "self-rated mental health" ($R^2 = 2.6\%$ to 3.0%) and "self-perceived stress" ($R^2 = 1.9\%$ to 2.1%). Multiple linear regression analysis revealed that "could not afford balanced meals - 12 mo.," "food situation in household - 12 mo.," and "worried food would run out - 12 mo.", formulated the strongest and most efficient model for both "self-rated mental" ($R^2 = 3.8\%$, $p < 0.001$) and "self perceived stress" ($R^2 = 2.7\%$, $p < 0.001$). **Implications:** Findings speak to the complexity involved in addressing mental health in relation to food security. A combination of variables such as daily stress, financial status, and food situation in households can act as predictors of mental health, and should be considered when informing policy decisions and interventions that alleviate both food insecurity and mental health and well-being in the Canadian population.

Food For Thought: A Secondary Analysis of Food Security Status, Mental Health Status, and Self-Perceived Stress in Canadian Households

During the COVID-19 pandemic, it is estimated that 11.2 percent of Canadians are food insecure in 2020 (Statistics Canada, 2022a). A study conducted in 2020 by Polsky and Gilmour (2020) showed that households experiencing moderate or severe food insecurity reported fair or poor mental health at rates that were more than double that of food-secure households. Food insecurity can be defined as "uncertain, insufficient or inadequate food access, availability and utilization due to limited financial resources, and the compromised eating patterns and food consumption that may result" (Health Canada, 2012, para. 2). This definition is drawn from the Household Food Security Survey Module (HFSSM), a validated tool used by the Canadian Community Health Survey (CCHS) in measuring food insecurity in Canada (Health Canada, 2012). Mental health can be defined as a state of well-being that is an integral component of health, which enables individuals to realize their own abilities, cope with the normal stresses of life, and work productively to make contributions to their community (WHO, 2022). To date, many studies have well established the association between food security status and mental health and well-being; however, some key knowledge gaps remain. Very few studies have examined the association between food insecurity and mental health in the Canadian context, which hinders the generalizability of findings to the Canadian population. This study aims to fill this gap and shed light on this ongoing social and health issue that impacts the lives of millions of Canadians each year by exploring the association between food security status, and mental health and well-being in Canadian households using 2004-2005 data from Cycle 2.2 of the CCHS. This study focused on mental health experienced as part of daily living and excluded mental illnesses such as psychosis and clinically diagnosed depression and anxiety. It is crucial for clinicians and other healthcare practitioners to learn more about the association between food security and mental health because they play a critical role in assessing the health status of patients. Our investigation will help provide guidance on future interventions that can better the well-being of vulnerable Canadians.

Conceptual Framework

We conducted a literature review of articles published between October 1st, 2017 and September 30th, 2022 to focus on the most current and up-to-date literature. Methodological key search terms were used including "food security," "food insecurity," "mental health," "well-being," and "stress." We opened our search to studies with participants of all ages with the following inclusion criteria: peer-review journal articles with full-text available in English investigating the relationship between food security status and mental health as part of daily living in human participants. Studies conducted on a global scale and in select countries including Canada, the U.S., European countries, and Australia were included to gain insight from countries with structural similarities to Canada. Studies conducted on special populations such as homeless people, refugees, war/armed conflict or disaster victims, pregnant women, and post-secondary students were excluded because these populations are subject to other extraordinary circumstances affecting mental health and overall well-being. Studies conducted on residents in the three territories, Indigenous Peoples, persons living in institutions, and full-time members of the Canadian Forces were also excluded since these populations were not part of the CCHS. We also excluded case reports, case series, and non-research articles such as commentaries, editorials, and opinions because they are lower on the hierarchy of evidence and may not provide high-quality insight into our topic. Lastly, studies where the association between food insecurity and mental health status could not be independently examined—due to the inclusion of unrelated variables—were excluded as they examined associations beyond the scope of this review. We used PubMed and the Cumulative Index to Nursing and Allied Health (CINAHL) as a search database. Within PubMed, we used the therapy and etiology filters within the clinical queries tool, and with CINAHL, we used the advanced search function to search keywords and the search option filters to limit our results to the inclusion criteria.

Our search initially revealed 402 articles. After the removal of duplicates and a series of screenings as outlined in Figure 1a (see Appendix A), a total of 19 articles met our selection criteria and were included in this review. Articles spanned over a number of countries (see Figure 1b in Appendix A) and had various study designs (see Figure 1c in Appendix A). Upon analyzing the main findings, we

found that a strong association between food insecurity status and mental health and well-being has been well established in a variety of contexts and was also found to be bidirectional by Bruening et al. (2017) and Maynard et al. (2018) (See Table 1, Appendix B). Findings in the literature are consistent in demonstrating that an increase in food insecurity is associated with a decrease in mental health and well-being whilst a decrease in food insecurity status predicts better mental health and well-being. Our search also revealed common themes, wherein the association between food insecurity status and mental health and well-being was moderated by sociodemographics, such as age, gender, region, income, and immigration status as outlined in Tables 2 and 3 (see Appendix B) and environmental factors, namely, community support and family dynamics as outlined in Tables 4 and 5 (see Appendix B).

Based on the strong association, more recognition of the psychological impact that food insecurity has on mental health and overall health is vital. To improve mental health, there needs to be an integrative approach to addressing food insecurity via formal and informal programs based on environmental, social, and psychological care principles that support food security status. Similarly, mental health must be addressed by adopting appropriate interventions. Moreover, it is crucial for clinicians and other healthcare practitioners to learn more about the association between food security and mental health because they play a critical role in assessing the health status of patients. It is important to keep these issues on the table to pressure government action by reflecting the negative consequences of food insecurity on health and well-being. Therefore, we wanted to further investigate the association between food security status and mental health status by analyzing the CCHS data and confirm the generalizability of the literature findings to the Canadian context. The literature provided extensive evidence of the association between food security and mental health, and yet such a study has not been done in Canada within the time frame of CCHS Cycle 2.2. Based on previous research, we hypothesized that there is an association between food security status and mental health and well-being.

Research Methodology

To examine our research question, we conducted a secondary analysis on data from the Canadian Community Health Survey Cycle 2.2 (CCHS 2.2). The CCHS is a cross-sectional survey administered

nationally that collects data regarding the population's general health and other specific health-related topics (Statistics Canada, 2005a). The CCHS 2.2 collected data from ten Canadian provinces, excluding the three territories. Individuals of all ages living in a private dwelling were qualified to participate, however, "individuals living on Indian Reserves and on Crown Lands, institutional residents, full-time members of the Canadian Forces and residents of certain remote regions" were excluded from the survey (Statistics Canada, 2005a, p. 15). The CCHS 2.2 used random sampling methods and had 35,107 respondents (Statistics Canada, 2005a, p. 47; Statistics Canada, 2008).

Details (and CCHS 2.2 codes) of the current study's variables are outlined in Table 6 (see Appendix C). Food security was analyzed as an independent variable using the variables "household food security status," "food situation in household," "worried food would run out - 12 mo.," and "could not afford to eat balanced meals - 12 mo."; these variables are key measures of food security status that illuminate Canadians' experiences of food insecurity. The variables "self-rated mental health" and "self perceived stress" were selected as our dependent variables representative of mental well-being; self-rated mental health is directly representative of Canadians' self perceived mental health while stress is highly associated with mental well-being (Schönfeld et al., 2016; Slimmen et al., 2022; Thoits, 2010).

Our secondary analysis included both descriptive and inferential statistics to better understand the CCHS 2.2 sample, and to generate findings that could be applied to the Canadian population. Inferential statistics were appropriate given CCHS's use of random sampling techniques and large sample size. Statistical tests were conducted using IBM SPSS Statistics Version 28. We conducted univariate analyses to evaluate each individual variable before we conducted Chi square, Pearson correlation, and bivariate linear regression tests between each independent and dependent variable. Multiple linear regression models for each dependent variable were also generated systematically.

Bivariate linear regression using the variable "household food security status" was established as our reference model for each dependent variable; it is the key variable of interest that is a direct measure of household food security status. Next, we built on the reference model by adding one additional independent variable at a time to generate new models. After having established a model that uses a

combination of all four ordinal independent variables, we systematically tested additional combinations using the independent variables with the strongest standardized coefficient betas to find the strongest model that uses the least number of independent variables for efficiency. The F statistics and p-values were evaluated for each linear regression model to determine the statistical significance of the models. The R squared was examined to determine the strength of the model while the standardized coefficient betas along with their p-values were analyzed to evaluate the relative contribution of each independent variable in predicting the dependent variable.

The CCHS dataset does not contain ratio-level variables that measure food security and mental health status. Therefore, we ran Pearson correlation, bivariate, and multivariate linear regression tests using ordinal-level variables as though they were ratio-level variables while being mindful of the limitations of ordinal-level data in our interpretations.

Results

The majority of the survey respondents were 18 years old or younger. There was a relatively equal portion of males and females, with females being slightly higher. Around 56% of respondents were single or never married, and most reported their education level as lower than secondary school. The majority of respondents self identified as White and non-immigrant. These variables, alongside other demographics, are summarized in Table 7 (See Appendix D). The majority of the sample (ranging from 83% to 93%) indicated that they were food-secure, always had enough food and the kind they wanted, never worried about running out of food, and were never unable to afford balanced meals. Approximately 15% of the sample had enough food but not the kind of food they wanted compared to around 9% of the sample that sometimes or often could not afford balanced meals. The self-rated mental health variable clustered on the more positive end of the spectrum with the median being “very good,” while self-perceived stress was more dispersed, with the median being “a bit,” in the middle of the spectrum. (see Table 8, in Appendix D for details)

We ran cross-tab analyses and Chi square tests for the dependent variables “self-rated mental health” and “self perceived stress” and all four independent variables, “household food security status,”

"food situation in household," "worried food would run out - 12 mo.," and "could not afford to eat balanced meals - 12 mo." Households with moderate or severe food insecurity reported poor mental health and extreme stress at more than eleven times and four times the rate of food-secure households, respectively (see Figures 2a and 2b in Appendix D). Chi square tests showed the independent and dependent variables were significantly associated with $p< 0.001$ (see Tables 9a and 9b in Appendix D).

We conducted Pearson correlation and bivariate linear regression for the two dependent variables of "self-rated mental health" and "self perceived stress," using the four ordinal-level independent variables "household food security status," "food situation in household," "worried food would run out - 12 mo.," and "could not afford to eat balanced meals - 12 mo." Results of the bivariate linear regressions are summarized in Table 10a and Table 10b (see Appendix D). Results show that all Pearson correlations have a $r < +/- 0.2$ and $p<0.001$. As seen in Table 10a, the bivariate analysis for the dependent variable "self-rated mental health" revealed that all four independent variables had similar R^2 values ranging from 2.6% to 3.0% with "could not afford to eat balanced meals - 12 mo." having the highest, $R^2 = 3.0\%$ $p<0.001$. The bivariate analysis for "self perceived stress" showed that "food situation in household" had the highest $R^2 = 2.1\%$ $p<0.001$, while "household food security status," "worried food would run out," and "could not afford to eat balanced meals" all had an equal $R^2 = 1.9\%$ $p<0.001$.

We ran a total of nine multiple linear regression analyses for each of the dependent variables using different combinations of the ordinal level independent variables "household food security status," "could not afford balanced meals - 12 mo.," "food situation in household - 12 mo.," and "worried food would run out - 12 mo." The multiple linear regression models for the dependent variable "self-rated mental health" are summarized in Table 11a (see appendix D). Models 4 and 9 had the highest $R^2 = 3.8\%$, $p<0.001$, followed by Models 3 and 8 $R^2 =3.7\%$, $p<0.001$. Comparing Models 4 and 9, the independent variable "food situation in household - 12 mo." (IV2) increased in its ability to predict the dependent variable "self-rated mental health" ($\beta 2 = -0.073 \rightarrow -0.077$, respectively). However, the independent variable "could not afford balanced meals - 12 mo." (IV4) demonstrated a larger increase in its ability to

predict the dependent variable ($\beta 4 = +0.065 \rightarrow +0.080$, respectively). Although Models 4 and 9 had the highest ability to explain the variability in the dependent variable, Model 9 was the most efficient in doing so; it consisted of only three statistically significant independent variables instead of four.

The multiple linear regression models for the dependent variable "self perceived stress" are summarized in Table 11b (see appendix D). Model 4 and 7 had the highest $R^2 = 2.7\%$, $p < 0.001$, followed by Model 3 and 6, $R^2 = 2.6\%$, $p < 0.001$. The independent variable "food situation in household - 12 mo." had $\beta 3 = +0.085$, $p<0.001$ for Model 4, and $\beta 3 = +0.088$, $p<0.001$ for Model 7; it was the highest predictor of the dependent variable "self-perceived stress" amongst the independent variables in both these models, followed by "worried food would run out - 12 mo.," which had a $\beta 4 = -0.044$, $p <0.001$ for Model 4 and $\beta 4 = -0.056$ $p <0.001$ for Model 7. The standardized coefficient beta of the independent variable "food situation in household - 12 mo." was 2.9 times that of the independent variable "household food security status" in Model 4. The independent variable "household food security status" was identified as having the weakest β for both "self-rated mental health" and "self perceived stress" in Model 4 , which combined all four ordinal level independent variables.

Discussion

Based on our analyses, there is a statistically significant relationship between food security status, stress, and mental health and well-being in the Canadian context. This finding is in line with our literature review, wherein the association between food security and mental health and well-being has been well established. The congruence of our results with the existing literature provides further support for the predictive relationship between food insecurity and mental health and well-being. Establishing this association in the Canadian context can help inform policies and interventions that alleviate both food insecurity and mental health and well-being in the population. Income-based solutions, such as higher minimum wage, that alleviate food insecurity may positively impact mental well-being as well (Men et al., 2021). Moreover, interventions, such as participation in urban agriculture (Audate et al., 2019), that benefit both food security and mental well-being may be more effective in improving the overall well-being of the people who suffer from these conditions. For interventions to be successful, it is

important to investigate the nuances of both food security and mental health and well-being. For example, a noticeable percentage of the sample (~15%) had enough food but not the kind of food they wanted. It is important to determine what foods these respondents wanted but were unable to acquire. One possibility could be high quality, fresh, and less processed foods as Moffat et al. (2017) have found that these foods are desired by newcomers in Canada. If this is the case, specific programs that facilitate access to such foods could help alleviate food insecurity.

Based on the Pearson correlation and bivariate linear regression tests, all the independent variables had statistically significant weak correlations and were similarly predictive of the change in both dependent variables. Consequently, the multiple linear regression revealed that "food situation in household - 12mo.," "could not afford balanced meals - 12 mo.," and "worried food would run out - 12 mo." made the strongest and most efficient model for explaining the variability in both "self-rated mental health" and "self perceived stress." These three independent variables were statistically significant weak predictors of both "self-rated mental health" and "self perceived stress." Although the variable "could not afford balanced meals - 12 mo." was the strongest predictor of "self-rated mental health" in this model, "food situation in household - 12 mo." was the strongest predictor of "self perceived stress." Several reasons can explain this relationship, including access to healthy foods, financial capacity, or the tendency of adults in food-insecure households to save healthy foods for their children by opting for unbalanced meals for themselves. For instance, Ovenell et al. (2022) found that households where parents were unable to shield their children from food insecurity were associated with poorer mental health outcomes compared to households where parents provided adequate shielding. This can lead to feelings of shame and guilt, coupled with distress from the inability to afford balanced meals; thus, worsening adults' mental health statuses (Lindow et al., 2022). Therefore, mental health and well-being can be affected by high levels of stress, anxiety, and depression, which arise from food insecurity (Ling et al., 2022).

All together, these findings speak to the complexity involved in addressing mental health in relation to food security. Rather, a combination of variables can interact with food security in predicting mental health, such as income, gender, immigration status, family dynamics, and level of community

support (Dou et al., 2022; Jones, 2017; Hammami et al., 2020; Ling et al., 2022; Pourmotabbed et al., 2020). In terms of the strengths of our study, the CCHS's large sample size and extensive sampling frame strengthens the possible generalizability of findings to most of the Canadian population (Statistics Canada, 2005a, p.15). Another strength of CCHS 2.2 is that it covers a variety of health topics, including 18 general health modules and a 24-hour dietary recall (Statistics Canada, 2005a). Some limitations of our study include the CCHS's cross-sectional design, which does not allow us to infer causality or directionality of the associated variables. Importantly, many Indigenous people were excluded from the survey, underestimating the severity of food insecurity in Canada. Approximately 19% of people with Aboriginal identity in 2021 were either experiencing low or very low food security (Statistics Canada, 2022d). The CCHS's failure to capture a sample that fully represents food insecurity in Canada limits the generalizability of our findings. Also, the CCHS 2.2 demographic information is quite different from the current Canadian population. For example, 86.9% of the current sample self-reported as White while in a recent 2021 survey, (Statistics Canada, 2022b) only around 70% of Canadians self-identified as White. And, according to the 2021 census, approximately 23% of the population were immigrants (Statistics Canada, 2022c), while only around 10% of the CCHS 2.2 sample were immigrants. Furthermore, the CCHS is vulnerable to survey-related biases, such as response bias. Lastly, the CCHS data available for secondary analysis does not include the original raw data and contains many derived variables, which can prevent certain analyses and an in-depth understanding of how data has been compiled and stratified.

Conclusion

Our research shows that low food security is associated with poorer mental health and well-being in the CCHS 2.2 sample. Households with food insecurity were more likely to report poor mental health and well-being. Weak positive correlations were found between various measures of food security status and both "self-rated mental health" and "self perceived stress," which shed light on how varying configurations of food insecurity are linked with poor mental health experiences. In particular, out of the variables investigated, the combination of household food situation, the ability to afford balanced meals, and anxiety over future food access best predicted the mental health and well-being of respondents. And

while being mindful of some of the limitations of the generalizability of the CCHS sample that we discussed, the association between food security and mental health and well-being is likely to exist among general Canadians due to the CCHS's large sample and random sampling technique. Our findings can be used as evidence that alleviating food insecurity through interventions could also potentially improve mental health; hence, interventions that support both food security and mental health and well-being may be more efficient than ones that only focus on one of the two issues. Our research also points to two forms of future studies. Future longitudinal studies should observe the changes in food security and mental health status in a given cohort to indicate the temporality and directionality of the association and help solidify evidence for a possible causal relationship among the variables. Additionally, future interventional studies can compare the effectiveness of programs that target both food security and mental health with interventions that focus only on food security. Our study results, in combination with findings from these future studies, can lead to a more efficient implementation of interventions that are crucial to support the many vulnerable Canadians who are suffering from food insecurity and associated lack of mental wellness.

References

Aguiar, A., Pinto, M., & Duarte, R. (2022). The bad, the ugly and the monster behind the mirror - Food insecurity, mental health and socio-economic determinants. *Journal of Psychosomatic Research*, *154*, N.PAG-N.PAG. https://doi.org/10.1016/j.jpsychores.2022.110727

Allen, N. L., Becerra, B. J., & Becerra, M. B. (2018). Associations between food insecurity and the severity of psychological distress among African-Americans. *Ethnicity & Health, 23*(5), 511-520. DOI: 10.1080/13557858.2017.1280139

Audate, P. P., Fernandez, M. A., Cloutier, G., & Lebel, A. (2019). Scoping review of the impacts of urban agriculture on the determinants of health. *BMC Public Health, 19*(1), 672. https://doi.org/10.1186/s12889-019-6885-z

Bell, Z., Scott, S., Visram, S., Rankin, J., Bambra, C., & Heslehurst, N. (2022). Experiences and perceptions of nutritional health and wellbeing amongst food insecure women in Europe: A qualitative meta-ethnography. *Soc Sci Med*, *311*, 115313. https://doi.org/10.1016/j.socscimed.2022.115313

Bruening, M., Dinour, L. M., & Chavez, J. B. R. (2017). Food insecurity and emotional health in the USA: a systematic narrative review of longitudinal research. *Public Health Nutrition*, *20*(17), 3200-3208. https://doi.org/10.1017/s1368980017002221

Ciciurkaite, G., & Brown, R. L. (2018). Food insecurity, psychological distress and alcohol use: understanding the salience of family roles for gender disparities. *Health Sociology Review*, *27*(3), 294-311. https://doi.org/10.1080/14461242.2018.1461574

Dou, N., Murray-Kolb, L. E., Mitchell, D. C., Melgar-Quiñonez, H., & Na, M. (2022). Food Insecurity and Mental Well-Being in Immigrants: A Global Analysis. *American Journal of Preventive Medicine*, *63*(2), 301-311. https://doi.org/10.1016/j.amepre.2022.02.006

Hammami, N., Leatherdale, S. T., & Elgar, F. J. (2020). Does social support moderate the association between hunger and mental health in youth? A gender-specific investigation from the Canadian Health Behaviour in School-aged Children study. *Nutrition Journal*, *19*(1), 1-11.

https://doi.org/10.1186/s12937-020-00648-3

Health Canada. (2012). *The household food security survey module (HFSSM)*. Government of Canada. https://www.canada.ca/en/health-canada/services/food-nutrition/food-nutrition-surveillance/health-nutrition-surveys/canadian-community-health-survey-cchs/household-food-insecurity-canada-overview/household-food-security-survey-module-hfssm-health-nutrition-surveys-health-canada.html

Islam, J. Y., Awan, I., & Kapadia, F. (2022). Food Insecurity, Financial Hardship, and Mental Health Among Multiple Asian American Ethnic Groups: Findings from the 2020 COVID-19 Household Impact Survey. In *Health Equity* (Vol. 6, pp. 435-447). © Jessica Y. Islam et al., 2022; Published by Mary Ann Liebert, Inc. https://doi.org/10.1089/heq.2021.0179

Johnson, A. D., & Markowitz, A. J. (2018). Food Insecurity and Family Well-Being Outcomes among Households with Young Children. *The Journal of Pediatrics*, *196*, 275-282. https://doi.org/10.1016/j.jpeds.2018.01.026

Jones, A. D. (2017). Food Insecurity and Mental Health Status: A Global Analysis of 149 Countries. *American Journal of Preventive Medicine*, *53*(2), 264-273. https://doi.org/10.1016/j.amepre.2017.04.008

Lindow, P., Yen, I. H., Xiao, M., & Leung, C. W. (2022). 'You run out of hope': an exploration of low-income parents' experiences with food insecurity using Photovoice. *Public Health Nutr*, *25*(4), 987-993. https://doi.org/10.1017/s1368980021002743

Ling, J., Duren, P., & Robbins, L. B. (2022). Food Insecurity and Mental Well-Being Among Low-Income Families During COVID-19 Pandemic. In *Am J Health Promot* (Vol. 36, pp. 1123-1132). https://doi-org.ezproxy.lib.ryerson.ca/10.1177/08901171221089627

Lund, J. J., Chen, T. T., LaBazzo, G. E., Hawes, S. E., & Mooney, S. J. (2021). The association between three key social determinants of health and life dissatisfaction: A 2017 behavioral risk factor surveillance system analysis. *Preventive Medicine*, *153*, N.PAG-N.PAG. https://doi.org/10.1016/j.ypmed.2021.106724

Marshall, G. L., Kahana, E., Gallo, W. T., Stansbury, K. L., & Thielke, S. (2021). The price of mental well-being in later life: the role of financial hardship and debt. *Aging & Mental Health*, *25*(7), 1338-1344. https://doi.org/10.1080/13607863.2020.1758902

Maynard, M., Andrade, L., Packull-McCormick, S., Perlman, C. M., Leos-Toro, C., & Kirkpatrick, S. I. (2018). Food insecurity and mental health among females in high-income countries. *Int J Environ Res Public Health*, *15*(7). https://doi.org/10.3390/ijerph15071424

Men, F., Urquia, M. L., & Tarasuk, V. (2021). The role of provincial social policies and economic environments in shaping food insecurity among Canadian families with children. *Preventive Medicine, 148*, 106558-106558. https://doi.org/10.1016/j.ypmed.2021.106558

Moffat, T., Mohammed, C., & Newbold, K. B. (2017). Cultural dimensions of food insecurity among immigrants and refugees. *Human Organization, 76*(1), 15-27. https://doi.org/10.17730/0018-7259.76.1.15

Ovenell, M., Azevedo Da Silva, M., & Elgar, F. J. (2022). Shielding children from food insecurity and its association with mental health and well-being in Canadian households. *Canadian Journal of Public Health*, *113*(2), 250-259. https://doi.org/10.17269/s41997-021-00597-2

Pak, T.-Y., & Kim, G. (2020). Food stamps, food insecurity, and health outcomes among elderly Americans. *Preventive Medicine*, *130*, N.PAG-N.PAG. https://doi.org/10.1016/j.ypmed.2019.105871

Polsky, J.Y., & Gilmour, H. (2020, December 16). *Health reports: Food insecurity and mental health during the COVID - 19 pandemic*. Statistics Canada. https://www.doi.org/10.25318/82-003-x202001200001-eng

Pourmotabbed, A., Moradi, S., Babaei, A., Ghavami, A., Mohammadi, H., Jalili, C., . . . Miraghajani, M. (2020). Food insecurity and mental health: a systematic review and meta-analysis. *Public Health Nutrition*, *23*(10), 1778-1790. https://doi.org/10.1017/s136898001900435x

Schönfeld, P., Brailovskaia, J., Bieda, A., Zhang, X. C., & Margraf, J. (2016). The effects of daily stress on positive and negative mental health: Mediation through self-efficacy. *International Journal of*

Clinical and Health Psychology, 16(1), 1–10. https://doi.org/10.1016/j.ijchp.2015.08.005

Slimmen, S., Timmermans, O., Mikolajczak-Degrauwe, K., & Oenema, A. (2022). How stress-related factors affect mental wellbeing of university students A cross-sectional study to explore the associations between stressors, perceived stress, and mental wellbeing. *Plos One, 17*(11), e0275925. https://doi.org/10.1371/journal.pone.0275925

Statistics Canada. (2005a). *Canadian community health survey 2004: User guide for the public use microdata file.* Statistics Canada: Health Statistics Division.

Statistics Canada. (2005b, October). *Canadian community health survey (CCHS) - Cycle 2.2 (Nutrition) 2004: Public use microdata file (PUMF). Derived and Grouped Variable specifications.* Statistics Canada.

Statistics Canada. (2008, April). Canada community health survey cycle 2.2 (2004): Nutrition - general health (including vitamin & mineral supplements) & 24-hour dietary recall component User Guide. Government of Canada. https://www23.statcan.gc.ca/imdb-bmdi/document/5049_D24_T9_V1-eng.pdf

Statistics Canada. (2022a, March 23). Table 13-10-0835-01 Food insecurity by age group and sex [Dataset]. https://doi.org/10.25318/1310083501-eng

Statistics Canada. (2022b, October 26) The Canadian census: A rich portrait of the country's religious and ethnocultural diversity. https://www150.statcan.gc.ca/n1/daily-quotidien/221026/dq221026b-eng.htm

Statistics Canada. (2022c, November 29) Focus on geography series, 2021 census of population. https://www12.statcan.gc.ca/census-recensement/2021/as-sa/fogs-spg/page.cfm?topic=9&lang=E&dguid=2021A000011124

Statistics Canada. (2022d, December 3) Table 41-10-0009-01 Food security by Aboriginal identity. [Data set]. https://doi.org/10.25318/4110000901-eng

Thoits, P. A. (2010). Stress and Health: Major Findings and Policy Implications. Journal of Health and Social Behavior, 51(1_suppl), S41–S53. https://doi.org/10.1177/0022146510383499

WHO. (2022, June 17). *Mental health: Strengthening our response.* World Health Organization. https://www.who.int/news-room/fact-sheets/detail/mental-health-strengthening-our-response

Yenerall, J., & Jensen, K. (2021). Food Security, Financial Resources, and Mental Health: Evidence during the COVID-19 Pandemic. *Nutrients*, *14*(1), 161. https://doi.org/10.3390/nu14010161

Appendix A

Figure 1a

Search Strategy Diagram

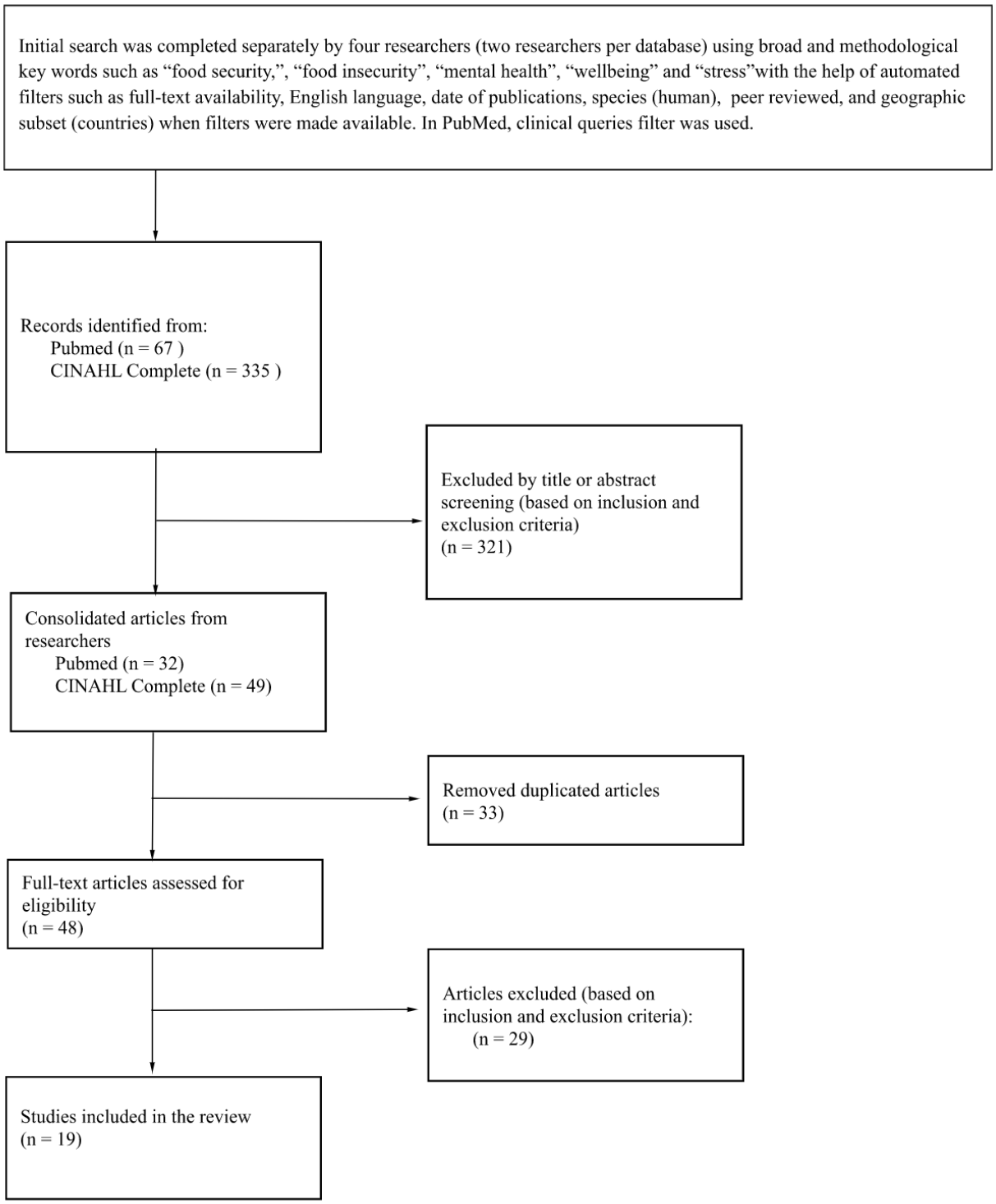


Figure 1b

Literature Review Summary by Geographic Area

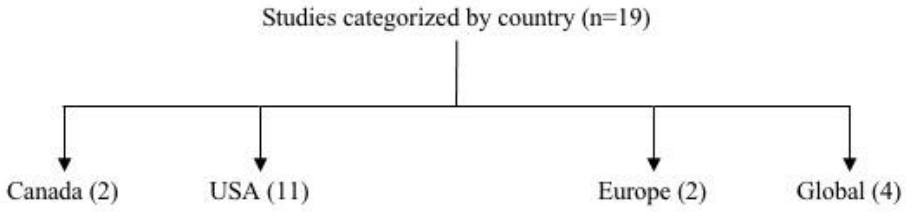
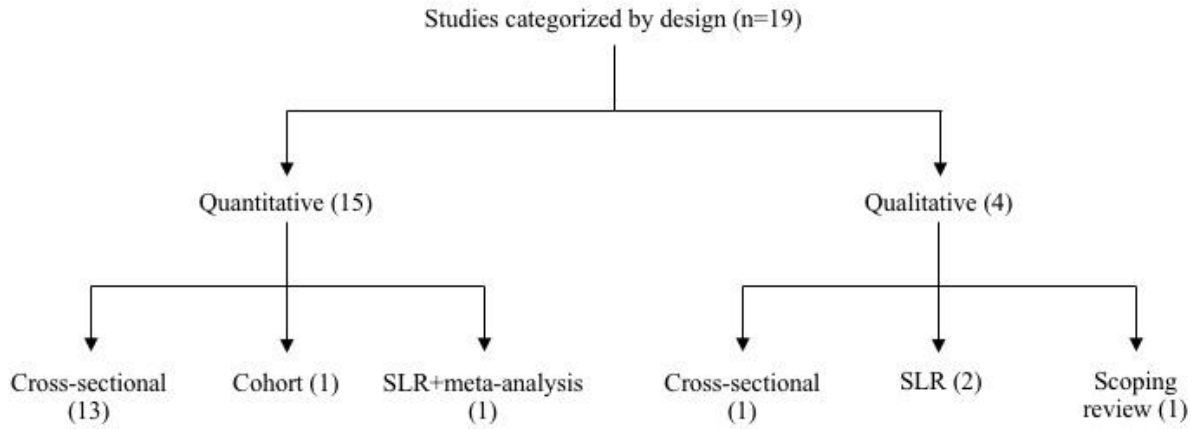


Figure 1c

Literature Review Summary by Study Design



Appendix B - Results of Literature Review

Table 1

Bidirectional association between food security and mental health

Source Citation	Research Question/ Focus	Population and Sample Size	Study Design	Methods and Measures	Statistical Analysis Methods	Main Outcomes (Author Stated)	Implications for Discussion/ Conclusion	Researcher Notes (limitations and follow up)
Bruening et al., 2017	Causal directionality in the relationship between food insecurity and emotional well-being among US-based populations	• 12 longitudinal studies assessing measures of food insecurity and emotional well-being of children and adults in the U.S.	Systematic literature review / Qualitative	Secondary Research Searched MEDLINE (PubMed), PsychInfo, Web of Science and CINAHL Final review included a total of 12 longitudinal studies assessing measures of food insecurity and emotional well-being of children and adults in the U.S.		Food insecurity increases the risk of poor emotional health, and poor emotional health increases the risk of food insecurity	The findings in this article suggests a bidirectional association where food insecurity increases the prevalence of poor emotional health and where increased poor emotional health increases the risk of food insecurity	• Several studies included small / homogeneous samples, limiting generalizability of these studies • A large number of measurement tools and outcome measures analyzed by the studies do not allow for meta-analysis • Emotional health outcomes were measured with several different scales, made it difficult to compare findings across studies

Maynard et al., 2018	Illustrate the state of the literature on food insecurity and mental health among women living in high-income countries	• 39 articles representing 31 unique studies/surveys capturing food insecurity and mental health of women living in high-income countries	Scoping review / Qualitative	Secondary research Used Pubmed, EMBASE, and psycINFO to capture reviews up to May 2016 Included articles that examined the associations between food insecurity and indicators of mental health and focused on high-income countries.		Several longitudinal studies observed relationships between depressive symptoms and food insecurity, with food insecurity increasing the risk of experiencing depressive symptoms, or changes in food insecurity are associated with changes in depressive symptoms	Evidence supports the link between food insecurity and compromised mental health among women in high-income countries with specific bidirectional associations between food insecurity and depressive symptoms	• The range of tools used make it difficult for comparison across studies • Formal quality appraisal of studies was not conducted • The use of abbreviated measures with limited sensitivity and specificity compared to full measures may have potentially restricted the scope of observed relationships

Table 2

The effect of income as a moderating factor between food security and mental health

Source citation	Research question/ Focus	Population and Sample Size	Study Design	Methods and Measures	Statistical Analysis Methods/ Qualitative Study Philosophy	Main Outcomes (Author Stated)	Implications for Discussion/ Conclusion	Researcher Notes (limitations and follow up)
Aguiar et al., 2022	Relationship between food insecurity and mental health		Cross-sectional / Quantitative	• Primary research • Online questionnaire between November 2020 and February 2021 • Data collected on socio-demographics, food security status, and mental health (i.e., anxiety and depressive symptoms) • Food insecurity measure: The US Household Food Security Survey Module (HFSSM) • Mental health measure: Hospital Anxiety and Depression Scale (HADS)	Crude and adjusted logistic regression models	• Less-educated participants with depressive and anxiety symptoms are more likely to belong to food-insecure households. • Reduction in income during COVID-19 and belonging to food-insecure households were associated.	Mental health issues (i.e., depression and anxiety) are critical factors to consider before introducing interventions to reduce food insecurity rates, or else interventions will be reductive.	• Need to specify the biological, psychological, and social factors that may deteriorate mental health. • Integrative approach based on environmental, social, and psychological care principles is needed.

Islam et al., 2022	Relationships between food insecurity, financial hardship, and mental health outcomes across various Asian ethnic groups in the United States during COVID-19	312 sample of self-identified Asian American ethnic groups from a weighted sample of 10,760 adults aged 18 and older drawn from the AmeriSpeak	Cross-sectional / Quantitative	• Secondary analysis of data from AmeriSpeak panel • Food insecurity measures: 1) Frequency of agreeing with "running out of food" and "not having enough money to get more food," OR 2) Receiving/requesting income assistance from a food pantry or the Supplemental Nutrition Assistance Program in the past 7 days. • Financial hardship measure: Self-reported action respondents would need to take if an unexpected $400 expense occurs. • Mental health measure: Self-reported number of days with symptoms of anxiety, depression, loneliness, and	Descriptive statistics, Chi-square, and Poisson regression	• Among all Asian American groups, Filipino+Vietnamese group and Japanese+Korean group had the highest and lowest prevalence of food insecurity and financial hardship, respectively. • High prevalence of food insecurity and financial hardship was associated with increased self-reported feelings of anxiety and hopelessness.	• Experience of food insecurity and more mental health symptoms were associated among Asian Americans during the COVID-19 pandemic. • Developing culturally and linguistically appropriate resources should be prioritized to help Asian Americans overcome the COVID-19 pandemic's negative impacts on mental health and finances.	• The study had difficulties in recruiting older Asian American population. • The study's cross-sectional design precludes establishing the temporality of the three main factors. • The study's small sample size prevented demonstrating associations between the main variables among disaggregated Asian American groups. • Future research should focus on: 1) investigating the reasons for the association between food insecurity and poor mental health, particularly in the context of Asian American social experiences; 2) The impact of English nativity on the socioeconomic impacts of the pandemic on Asian Americans.

				hopelessness within the last 7 days.				
Marshall et al., 2021	Relationship between financial hardships and debt indicators and mental health status among older adults	•7,678 participants aged over 50 with/without depressive symptoms and 8,079 participants aged over 50 with/without anxiety from the 2010 Health and Retirement Study • Some participants (15%) had both depressive symptoms and anxiety • Multistage area probability sampling	Cross-sectional / Quantitative	• Secondary analysis of the 2010 Health and Retirement Study in the US • Depressive symptoms measure: Eight-item modified version of the 20-item CES-D scale. • Anxiety measure: Five items of the Beck Anxiety Inventory. • Food insecurity was used as one of the indicators for financial hardship.	Spearman correlation coefficients	Depressive symptoms and anxiety were experienced more by older adults who reported difficulty paying their bills, being food insecure, having medical debt, or delaying medications due to cost.	• Difficulty paying bills and delaying taking medications due to cost had strongest association with mental health symptoms. • Findings suggest that inability to meet financial needs may jeopardize older adults' mental health more than food insecurity does. • Credit card debt was not associated with mental health symptoms.	• Present data cannot establish causality, and future prospective studies are needed. • Findings emphasizes the importance of providing food-insecure or medication-insecure individuals with financial safety nets to reduce mental health risks.

Yenerall & Jensen, 2021	The role of financial resources in understanding the relationship between food security and mental health among U.S. household	2000 US citizen over 18 years of age who are the household's primary food shopper (a national convenience sample)	Cross-sectional / Quantitative	Primary research Data were collected using an online survey administered by Qualtrics in July 2020 Measures of household food security status: • The USDA-ERS six-item short form version of the USDA-ERS U.S. Measures of mental health: • Questions adapted from the Behavioural Risk Factor Surveillance Systems (BRFSS) Analysis of financial resources related to the pandemic: • Monthly income in June 2020 as compared to January 2020	Weighted multinominal and ordered proportional logistic regression	A decline in monthly income and the use of savings to pay for bills are directly associated with both food security status and mental health outcome The use of savings to pay for bills increased the likelihood of either low or very low food security and increased the odds of more days of poor mental health in the past month A decline in monthly income increased the likelihood of very low food security and the odds of more days or poor mental health in the past month	Association among financial resources, food security, and mental health status of households are found during the pandemic During the pandemic, the number of reported poor mental health days were related to job loss and the need to draw from savings to pay for bills.	• The study uses cross-sectional data, and the results cannot be used to infer a causal relationship • The study used a general measure of mental health that only captures days of poor mental health, making it difficult for comparisons with other studies

Table 3

The effect of age/gender/region/immigration as moderating factors between food security and mental health

Source Citation	Research Question/ Focus	Population and Sample Size	Study Design	Methods and Measures	Statistical Analysis Methods/ Qualitative Study Philosophy	Main Outcomes (Author Stated)	Implications for Discussion/ Conclusion	Researcher Notes (limitations and follow up)
Allen et al., 2018	Relationship between food insecurity (with and without hunger) and both mild to moderate psychological distress (MPD) and serious psychological distress (SPD) among African-Americans	• 4,003 African-American adults from the 2009 and 2011/2012 California Health Interview Survey (CHIS) • Random sampling	Cross-sectional / Quantitative	Secondary analysis of data from the 2009 and 2011/2012 CHIS Psychological distress measure: Kessler-6 scale (8-12 score = MPD) (13+ score = SPD) Food security status measure: Questions from CHIS about food insecurity experiences (e.g., running out of food)	Descriptive statistics and Chi-squared analyses	Prevalence of mild to MPD was higher among food-insecurity-without-hunger individuals while SPD was highest for food-insecurity-with-hunger individuals Compared to those living at or above 200% Federal Poverty Level, odds of SPD was six-times higher in African-Americans with food-insecurity-with-hunger	• Hunger has a significant role in the association between SPD and food insecurity. • Two distinct groups of food insecure individuals with psychological distress: Group 1) transient food insecurity associated with mild to MPD; Group 2) chronic food insecurity associated with SPD. This distinction can be important in the design and implementation of interventions. • Improving the efficacy of formal	• Cross-sectional design limits the ability to interpret causality. • Generalizability limited to California. • Future research should investigate if the same pattern can be found in other ethnicities and when using different mental well-being indicators.

							and informal food support networks can improve the collective health and well-being of Black/African-American communities that suffer from food insecurity or hunger. • Expand the utilization and availability of integrated care models.	

Dou et al., 2022	Prevalence of food insecurity and its association with the mental well-being of immigrants on a global and regional scale.	• 36,313 immigrants and 705,913 nonimmigrant adults aged 15 years and older in 159 countries globally from the Gallup World Poll (GWP) 2014-2019 • Random sample	Cross-sectional / Quantitative	• Secondary analysis of data from the GWP 2014-2019 • Immigration status measure: Response to the question “Were you born in this country, or not?” • Food security measures: Food Insecurity Experience Scale • Mental well-being measure: Negative Experience Index (NEI) and Positive Experience Index (PEI) • Measure of respondents' satisfaction with the community they live in and their likelihood to recommend this community to others: 2-item	Multilevel mixed-effect linear models	• Close to 39% of the immigrants sampled were food insecure. • Food insecurity was dose-responsively associated with lower mental well-being. • Community attachment marginally affected the food insecure-mental well-being association. • Immigration status significantly modified the food insecure-mental well-being association. • Immigrants experienced lower mental well-being than nonimmigrants at the same level of community attachment and food insecurity.	• Food insecurity and poor mental health are associated, and experienced by immigrants worldwide. • A better-perceived living environment may alleviate poor mental experiences, especially among severely food-insecure groups. • Characteristics of immigrants can impact both food insecurity and mental well-being. • Immigrants in the Asia and Pacific regions appeared to report worse mental well-being than nonimmigrants at moderate and severe food insecurity levels, possibly because the dominant form	• The study design could not determine the directionality of the relationship between food insecurity and mental well-being. • Findings could be confounded by unmeasured factors, such as chronic conditions and governmental assistance programs. • The 1-item question assessing immigration status does not discriminate the length of stay and reason for immigration. • The differences in data reference period on food insecurity (in the past 12 months) and mental well-being (in the last 24 hours) limited the ability to infer temporality. • Socioeconomic status characteristics differ between the included and excluded immigrant sample and findings may not be generalizable to all

				Community attachment index			of immigration in these regions is as a temporary labour force and government benefits may not cover this group.	immigrants worldwide.
Jones, 2017	Relationship between individual-level food insecurity and mental health status 149 countries around the world, and the variables that modify this relationship (including global region, age, and sex).	147,826 respondents aged 15 years and older were taken from 100-135 sampling units (clusters of households) of the 2014 Gallup World Poll (GWP). Sampling unit selection: population size probabilities and random sampling. Respondent selection: random sampling.	Cross-sectional / Quantitative	Secondary analysis of telephone/in-person interview survey data from the GWP Individual-level food insecurity measure: Food Insecurity Experience Scale Survey Module for Individuals (FIES SM-I) Mental health status measures: The Negative Experience Index (NEI) and Positive Experience Index (PEI)	• Multiple linear regression models • Multiple logistic regression models	Globally, individual-level food insecurity was associated with lower mental health status, and severity of food insecurity predicted worsened mental health status. Older adults had stronger positive association between food insecurity and NEI, and stronger inverse association between food insecurity and PEI. Region modified the moderating effects of age in	Food insecurity is associated with negative mental health status, and this association exists across contexts and despite sex and world region.	• The cross-sectional design does not permit conclusions about directionality and causality of the association. • Temporality cannot be established due to varying recall periods for the study's three measures. • The two GWP surveying methods (i.e., telephone and in-person) can introduce different biases to respondents' answers and affect within-region analyses for countries that had more in-person surveying.

						within-region analyses: age moderated the association only in middle- and high-income areas. Individual-level food insecurity was associated with higher odds of recent negative feelings. Individual-level food insecurity was associated with lower odds of recent positive feelings.		

Pourmotabbed et al., 2020	Food security as a risk factor for depression, stress and anxiety	372,143 adult participants from 10 different countries collected from 19 studies	Systematic review and meta-analysis / Quantitative	Secondary research Relevant studies were identified by searching Web of Science, Embase, Scopus, and PubMed databases up to January 2019 Included: Observational studies reporting on the association between food insecurity and depression, stress, and anxiety Excluded: Studies on participants under 18 years of age Conducted quality assessment for individual studies	Study-specific maximally adjusted ORs	• There was a positive relationship between food insecurity and risk of depression and stress, but not anxiety. • Subgroup analysis by age showed that subjects older than ≥65 years exhibited a higher risk of depression than younger participants; a greater risk of depression is also found in men than women. • Subgroup analysis according to geographical location illustrated that food insecure households living in North America had the highest risk of stress and anxiety.	Food insecurity has a significant effect on the likelihood of being stressed or depressed, and healthcare services which alleviate food insecurity, could also promote holistic well-being in adults.	• A high percentage of heterogeneity was observed which may be due to the small number of studies (less than ~10 studies) on anxiety. • The study did not undertake an assessment of the grey literature and only worked with studies written in English. • The impact of other potential biases including demographic, lifestyle and clinical variables, and genetic background could not be assessed. • Subgroup analyses had to be undertaken due to high heterogeneity which reduced statistical power.

Table 4

The effect of community support as a moderating factor between food security and mental health

Source Citation	Research Question/ Focus	Population and Sample Size	Study Design	Methods and Measures	Statistical Analysis Methods/ Qualitative Study Philosophy	Main Outcomes (Author Stated)	Implications for Discussion/ Conclusion	Researcher Notes (limitations and follow up)
Hammami et al., 2020	Gender differences and the role of social support as a moderating factor for Canadian youth's experience of hunger and mental health.	21,750 youth in grades 6-10, from 287 schools across 12 Canadian provinces and territories from the 2017/2018 school-based survey cycle of the Canadian Health Behaviour in School-aged Children study (HBSC-Canada) • Probability sampling	Cross-sectional / Quantitative	Secondary analysis of data on self-reported hunger, mental health, and sources of support from peers, family, teachers, schools, and neighborhoods from the school-based survey cycle of HBSC-Canada. Mental health measures: World Health Organization-5 (WHO-5) mental well-being index. Hunger measure: Students were	Chi-squared test, multivariate analysis, and adjusted gender-specific multilevel regression analysis	All social support factors were positively associated with mental health, but did not overpower the negative effects of hunger on mental health. Perceptions of support were lower in youth having experienced hunger than youth never having experienced hunger. Hunger in female youth was more strongly associated with poor mental health than	Hunger was associated with lower odds of mental health. The associations between social support and mental health as well as hunger and mental health are different across genders based on their differential stress perceptions and coping mechanisms.	The study only measured food-insecurity via hunger, limiting comparison to studies using other food-insecurity measures. A limitation of the study was that measures for support were subjective. Social support was only investigated in terms of emotional support, and did not examine other related factors, such as sense of belonging. Future studies should look at the effects of different forms of social and community support as moderating factors for mental health in

				asked: “Some young people go to school or to bed hungry because there is not enough food at home. How often does this happen to you?” Based on their answer, they were categorized as “ever hungry” and “never hungry.”		hunger in male youth. Some social support factors were more strongly associated with better mental health in female youth than male youth.		food-insecure individuals with and without hunger. The study was limited to the HBSC-Canada sample, which covered schools in all provinces and territories except for Nunavut, thus the sample possibly under-represents certain rural and Indigenous populations. Future studies should compare the effects of different social support measures on mental health and whether these results are related to differences in male/female perceptions of support and hunger. Cross-sectional design could not examine the longitudinal associations between hunger and mental health starting in early-life.

Lund et al., 2021	Relationship between three social determinants of health (i.e., housing insecurity, food insecurity, and financial instability) and life dissatisfactio n, and the moderating effects of emotional and social support and mental distress on this association.	• 25,850 American adults ages 18 and over from Minnesota, Wisconsin, and Ohio surveyed in the 2017 Behavioral Risk Factor Surveillance System (BRFSS).	Cross-sectional / Quantitative	• Secondary analysis of data from the 2017 BRFSS. • Social determinants of health measure (SDOH): SDOH module in the BRFSS. • Life satisfaction measure: 1 item in the 2-item Emotional Support and Life Satisfaction module in the BRFSS. • Emotional support measure: 1 item in the 2-item Emotional Support and Life Satisfaction module in the BRFSS. • Frequent mental distress (FMD) measure: In the previous month, self reporting 14	Descriptive analyses, crude prevalence differences, and Mantel-Haenszel stratified analysis.	• Respondents with the three SDOH were more likely to report overall life dissatisfaction. • FMD and lower social and emotional support were more highly linked to individuals with the three SDOH.	• Emotional and social support mediates the odds of experiencing the SDOH and reporting FMD; therefore, support might be important for mental well-being. • Food insecurity was one of the SDOH variables, which were linked to life dissatisfaction, showing a relationship between food insecurity and well-being.	• Cross-sectional design cannot establish causality. • Only data from the three states of Minnesota, Wisconsin, and Ohio were used, which limits generalizability • The emotional support measure was based on only one item in the Emotional Support and Life Satisfaction module. This might not capture various types of support. • The study spent little time reviewing the link between food insecurity and mental health since its primary focus was on the link between adverse social determinants of health and life satisfaction.

				days or more of poor mental health.				
Pak & Kim, 2020	Relationship between very low food security and health outcomes in older adults and if participation in the Supplemental Nutrition Assistance Program (SNAP) reduces adverse health consequences associated with very low food insecurity.	• 148,138 observations from 27,281 Americans and 18,524 US households from the 1998-2014 surveys of the Health and Retirement Study (HRS).	Cross-sectional / Quantitative	• Secondary analysis of food insecurity and SNAP data from the 1998-2014 surveys of the HRS. • Food insecurity measure: Participant's answers to the questions, "Since the previous interview/In the last two years, have you always had enough money to buy the food you need?" and "In the last 12 months, did you ever eat less than you felt you should because there wasn't enough money to buy food?" • SNAP participation	Individual fixed regression	• SNAP participants had a higher chance of having clinical depression associated with food insecurity. • SNAP participation was correlated with negative self-attitudes.	The study indicates that the stigma associated with SNAP participation might hinder psychological well-being of food-insecure people.	• Welfare stigma in association with depressive symptoms may not be generalizable to younger people, and future research should examine the experience of younger adults. • Future research should use clinically-validated measures of major depression and examine the effectiveness of counseling as an intervention.

				measure: Participants' answers to the questions, “Did you (or other family members who were living here) receive government food stamps at any time since the previous interview/in the last two years?” and “Are you (or other family members who are living (here/there)) still receiving food stamps?” • Measures of mental health: 1) Abridged eight-item version of the 20-item Center for Epidemiologic Studies (CES-D) scale; 2) a binary indicator of clinical depression.				

Table 5

The effect of family dynamics as a moderating factor between food security and mental health

Source citation	Research Question/ Focus	Population and Sample Size	Study Design	Methods and Measures	Statistical Analysis Methods/ Qualitative Study Philosophy	Main Outcomes (Author Stated)	Implications for Discussion/ Conclusion	Researcher Notes (limitations and follow up)
Bell et al., 2022	Explore women's experience of food insecurity and its effects on nutritional health and well-being	• 23 publications with 22 unique studies reporting the accounts and experiences of nutritional health and well-being of a total of 647 women of childbearing age (between 16 and 55) from a variety of ethnicities reporting food insecurity	Systematic literature review / Meta-ethnography of qualitative studies / Qualitative	Searched Scopus, MEDLINE, EMBASE, CINAHL, Applied Social Science Index (ASSIA) and Web of Science	According to Noblit & Hare's seven phases of meta-ethnography Identified key themes and sub-themes emerging across studies via synthesis of a storyline of women's experience of food insecurity	Identified 2 key themes and subthemes: 1. Accessing sufficient food • Strategic adjustments • Accessing charitable food aid • Informal Support Networks • Healthy Start vouchers (in the UK) 2. Embodying food insecurity • Inability to meet own nutritional needs • Maternal sacrifice • Physical and mental health and well-being	There is a lack of qualitative change over time with regards to women's experiences of food insecurity Lone mothers and migrant women were particularly vulnerable to more severe experiences of food insecurity as the only groups of women who articulate resignment to food insecurity There needs to be more recognition of the psychosocial impact of food insecurity on vulnerable women and its impact on their nutritional health and well-being	• There needs to be greater recognition of the psychosocial impact of food insecurity on vulnerable women in addition to its impact on their nutritional health and well-being • There is a lack of studies from non-UK European countries • Review is subject to publication bias. • This review includes a diverse range of included studies from different European contexts, which may have different welfare states, social security, food aid, and health care systems making comparison difficult

						Food insecurity directly and tangibly impacts women's nutritional health and wellbeing		
Ciciurkaite & Brown, 2018	• Gender differences in depressive symptoms and alcohol-use and their link to food insecurity. • Marital status and parental status as predictors of depressive symptoms.	• 11,539 non-institutionalized U.S. civilians 18 years and older from the 2011–2012 and 2013–2014 cycles of the National Health and Nutrition Examination Survey (NHANES) • Random sampling	Cross-sectional / Quantitative	• Secondary analysis of data from the 2011–2012 and 2013–2014 cycles of the NHANES. • Depressive symptoms measure: Patient Health Questionnaire (PHQ-9) • Household food insecurity measure: 18-item scale comprised of 12 Likert-type and 6 yes/no questions • Food insecurity conceptualized as a form of chronic strain	Six models of regression	• Food-insecure households experienced higher levels of depressive symptoms than their food-secure counterparts. • Women experienced greater depressive symptoms than men. • Marriage acted as a greater protective factor against psychological distress in men than women. • Having children under 18 years of age was associated with lessened psychological distress in women, however these mental benefits are reduced in low and very low food insecure households.	There are differences in the experience of psychological distress associated with food insecurity, based on gender and family context.	• Cannot establish causality or bidirectionality due to study's cross-sectional design. • Findings support the need to consider gender differences when planning interventions that target both nutrition and psychological and behavioural health. • Food insecurity was measured via economic constraints and did not consider other sources of food insecurity (e.g., disability and old age). • The Patient Health Questionnaire (PHQ-9) is a less commonly used measure, making comparisons across studies difficult. • Although the study controlled for age, income, education, race/ethnicity, and employment, it did not control for other relevant social determinants of health such as social support

								outside of the home environment.
Johnson & Markowitz, 2018	Relationship between household food insecurity and multiple variables of family well-being to highlight previously understudied, policy-amenable mechanisms through which food insecurity threatens healthy development	• 2100-4700 subsample of children with valid food insecurity and income data 185% below poverty line drawn from the first three waves of the Early Childhood Longitudinal Study—Birth Cohort	Cohort Study / Quantitative	Secondary analysis of a data from a cohort study the first three waves of the Early Childhood Longitudinal Study—Birth Cohort (Wave 1 in 2001 and 9 months old; Wave 2 in 2003 and 2 years old; and Wave 3 in 2005-2006 while in preschool), a US nationally representative study of children	Regression models with lagged dependent variables	• Household food insecurity was associated with poorer maternal physical health, increased depressive symptoms and greater frequency and negativity of conflict between parents. • The association between food insecurity and family associations were strongest and most consistent when children were preschool aged. • The transition into food insecurity between toddlerhood and preschool were associated with significantly worse parental physical and mental health outcomes, and more family conflict	• Food insecurity is associated with significant decreases in family health and well-being. • Screening families who are at risk for food insecurity and connecting them with resources is an avenue through which public health practitioners can support family health.	• The study relied exclusively on maternal self-report for both food insecurity and all dependent variables which can introduce possible reporting bias • The results can be a reflection of maternal depressive symptoms that contribute to food insecurity or food insecurity's contributing to increased maternal depressive symptomatology; causality is unclear.

Lindow et al., 2022	Parents' lived experiences of food insecurity based on their household food management, ability to provide for their families, and food insecurity's impact on their mental health.	• 17 low to very low food-insecure parents from San Francisco Bay Area, between ages 28 to 61 years, and identifying as non-Hispanic White, Black/African American, Hispanic and multi-racial, Native Hawaiian/Pacific Islander, or American Indian/Alaskan Native.	Phenomenology / Qualitative	• Primary research • Photovoice study conducted between June 2016-January 2017 • Food insecurity measure: US Department of Agriculture 18-item Household Food Security Survey Module • Researchers formalized research question • Participants took/sent photos over 2 weeks and had a 30-min follow-up semi-structured interview to discuss photos.	Researchers developed codebooks to identify emerging and common themes.	• Four common themes were identified: 1. Food environment promotes unhealthy eating. 2. The use of creative strategies to acquire food with limited resources. 3. Psychological distress due to food insecurity. 4. Treating children to special foods to cultivate normalcy. • Psychological distress revealed itself as feelings of shame, guilt, and distress and was tied to parents' perceived ability to provide adequate or nutritious food for their kids.	Parents experience of food insecurity was often tied to increased psychological distress often revealed as feelings of shame, guilt and distress often tied to their perceived limited capacity in providing adequate or nutritious food for their children	• Participants were asked to interpret the research question broadly, allowing parents to share the narrative of their choice, and help inform policy makers of current issues to consider in future development of food assistance programs. • Further investigation and qualitative analysis regarding mediating factors of parental distress based on sociodemographic factors may reveal differences in experience. • The qualitative analysis provides insight into the variables that contribute to poor mental health in food-insecure individuals, but the lack of measures of negative mental health outcomes limits comparison to the many quantitative studies on the topic. • Limited engagement from participants required that the Photovoice method be adapted.

Ling et al., 2022	Relationship between the effects of adult and child food insecurity on parent's and children's mental well-being	• 408 U.S. parents aged 18 to 65 years (with a mean age of 31) living under the poverty level and with children aged 3-5 years (17% Hispanic, 21% Black)	Primary research / Cross-sectional / Quantitative	Study participants were recruited by email from one urban and one rural Head Start organization and online via the Qualtrics Panel to participate in an online survey Assessment of food insecurity: • The U.S. Household Food Security Survey Module. Measures of well-being: • Parents' stress, anxiety, and depression; and children's sadness, fear, anger, and positive affect using instruments from Health Measures	Multivariate general linear models	• Parents with food insecurity had higher levels of stress, anxiety, depression, and fear in their children compared to those without adult food insecurity. • Parents reporting child food insecurity had greater depressive symptoms than those who did not report child food insecurity. • Black parents had lower stress, anxiety, and depression than their White counterparts.	The study's results underscore the importance of reducing food insecurity in both parents and children as a whole family system to promote mental well-being of low-income families.	• Parents may have under- or overestimated children's mental well-being. In future studies, objective measures, such as cortisol testing, to assess preschoolers' mental well-being are recommended. • The sampling approach may have failed to represent low-income families with very limited internet access or literacy levels. • Self-reported online surveys were completed by parents to avoid in-person interactions due to the COVID-19 pandemic, possibly resulting in social desirability and recall bias.

Ovenell et al., 2022	Relationship between adults' sacrifice of personal nutritional needs in shielding children from malnutrition on mental health and well-being	• 28,871 youth and 74,416 adults from three cycles of the Canadian Community Health Survey living in food insecure households	Secondary research / Cross-sectional / Quantitative	Secondary analysis of data from three cycles (2007-2008, 2011-2012, and 2017-2018) of the Canadian Community Health Survey living in food insecure households	Poisson regression	• About one in six (15.3%) households with children were food insecure and one-third of food insecure households (6.3%) included children who were shielded from experiencing food insecurity. • Shielded youth did not differ significantly from food-secure youth in three of the five outcomes examined. • Unshielded youth compared to food-secure youth showed increased risks for every health outcome investigated. • Adults in food-insecure households also reported worse mental health than food-secure adults but better mental health if children were shielded.	• Shielding is associated with a reduced risk of common psychiatric outcomes and poor mental health in youth and adults, possibly because it is associated with milder forms of food insecurity. • The inability to protect children from having inadequate access to food may compound the psychological strain of food insecurity on mental health and well-being in adults. • Adults might be better able to shield children from milder forms of food insecurity. • Adults with better mental health and well-being are in a better position to shield.	• The effects of parental mental distress on children's mental health cannot be controlled. • The intensity or severity of food insecurity as a factor increasing higher risks in mental health cannot be clearly differentiated from the effect of shielding.

Appendix C - Key Variables

Table 6

Key Variables for the Analysis of Food Security, Stress, and Mental Health and Well-being

Variables*	Details	Levels
Dependent Variables		
Self-rated mental health (GENDDMHI)	Derived from variable 'Self-perceived mental health' that captures the respondents' answers to the statement "In general, would you say your mental health is:"	Excellent Very Good Good Fair Poor
Self perceived stress (GEND_07)	The variable measured stress among CCHS 2.2 respondents that were 15 years or older. Respondents had to answer the question: "Thinking about the amount of stress in your life, would you say that most days are:"	Not at all stressful Not very stressful A bit stressful Quite a bit stressful Extremely stressful
Independent Variables		
Household food security status (FSCDDHFS)	Derived variable that categorizes respondents based on the pattern of affirmative responses captured on a set of 18 questions that are based on the U.S. model of food security status levels published by the U.S. Department of Agriculture in 2000. Respondents were asked to reflect on their situation in the previous 12 months.	Food Secure Food insecure without hunger Food insecure with moderate hunger Food insecure with severe hunger
Food Situation in Household (FSCD_010)	The variable assessed all respondents' answers to: "Which of the following statements best describes the food eaten in your household in the past 12 months?"	Always had enough kinds of food wanted Enough, but not always kinds wanted Sometimes did not have enough Often did not have enough
Worried food would run out - 12 mo. (FSCD_020)	The variable assessed all respondents' level of agreement with: "You and other household members worried that food would run out before you got money to buy more."	Often true Sometimes true Never true
Could not afford to eat balanced meals - 12 mo. (FSCD_040)	The variable assessed all respondents' level of agreement with: "You and other household members couldn't afford to eat balanced meals" in the past 12 months.	Often true Sometimes true Never true

*****All variables' details are drawn from Canadian Community Health Survey (CCHS) - Cycle 2.2 (Nutrition) 2004: Public use microdata file (PUMF). Derived and Grouped Variable specifications (Statistics Canada, 2005b)

Appendix D - Results

Table 7
Univariate Demographic Characteristics

Characteristic	Frequency (n)	Percentage (%)
Age*		
≤18 years old	14910	42.5
≥19 - 30 years old	3984	11.4
≥31 - 40 years old	2392	6.8
≥41 - 50 years old	3297	9.4
≥51 - 60 years old	3516	10.0
≥61 - 70 years old	2626	7.5
≥71 years old	4382	12.5
Sex		
Male	16532	47.1
Female	18575	52.9
Marital status		
Married	8706	24.8
Common-law	1573	4.5
Widow/Separated/Divorced	5128	14.6
Single/Never Married	19653	56.1
Household size		
1 Persons	6969	19.9
2 Persons	9315	26.5
3 Persons	6559	18.7
4 Persons	7848	22.4
5 or more Persons	4416	12.6
Highest level of education in household		

Less than secondary school graduation	19327	55.4
Secondary school graduation, no postsecondary education	4029	11.5
Some post-secondary education	2217	6.4
Post-secondary degree/diploma	9333	26.7
Immigration status		
Yes	3730	10.6
No	31297	89.4
Total household income - main source		
Wages/salaries or self-employment	24921	73.4
Employment insurance or worker's compensation or social assistance/welfare	1741	5.1
Canada or Quebec pension or retirement pensions or old age security/GIS	6073	17.9
Dividends/interest or child tax benefit or child support or alimony or other or no income	1198	3.5
Language(s) in which respondent can converse		
English (with or without another language other than French)	25445	72.6
French (with or without another language other than English)	3311	9.4
English and French (with or without other language)	5769	16.5
Other (neither English nor French)	521	1.5
Cultural or racial origin		
White	30464	86.9
Other	4583	13.1
Living arrangement of selected respondent		
Unattached individual living alone	6966	20.0
Unattached individual living with others	1188	3.4

Spouse/partner living with spouse/partner	6720	19.3
Parent living with spouse/partner and children	2682	7.7
Single parent living with children	715	2.1
Selected respondent is a child living with a single parent with or without siblings	2913	8.4
Selected respondent is a child living with two parents with or without siblings.	11613	33.3
Other	2059	5.9
Job status over past year		
Has had a job throughout the past year	9313	44.2
Was without a job and looking or not for work throughout the past year	6288	29.9
Has had a job part of the year – was without a job and looking or not for other part of the year	5462	25.9

*In the CCHS 2.2, there are 16 levels in the age variable, which we have collapsed into seven levels for data simplification.

Table 8
Univariate Analyses of Study Variables

Characteristic	**Frequency (n)**	**Percentage (%)**	**Median**
Household food security status			
Secure	32210	92.3	Secure
Food insecure without hunger	1772	5.1	
Food insecure with moderate hunger	714	2.0	
Food insecure with severe hunger	198	0.6	
Food Situation in household			
Always had enough kinds of food wanted	29109	83.0	Always Enough
Enough, but not always kinds wanted	5304	15.1	
Sometimes did not have enough	464	1.3	

Often did not have enough	174	0.5	
Worried food would run out - 12 mo.			
Often True	890	2.5	Never True
Sometimes True	2905	8.3	
Never True	31238	89.2	
Could not afford to eat balanced meals - 12 mo.			
Often True	758	2.2	Never True
Sometimes True	2250	6.4	
Never True	32013	91.4	
Self-rated mental health			
Poor	241	0.9	Very Good
Fair	1091	4.1	
Good	5598	20.9	
Very Good	9764	36.5	
Excellent	10038	37.6	
Self-perceived stress			
Not at All	3120	13.0	A Bit
Not Very	6434	26.8	
A Bit	9533	39.7	
Quite a Bit	4160	17.3	
Extremely	778	3.2	

Table 9a
Chi Square Tests between independent variables of interest and the dependent variable, Self Rated Mental Health (GENDDMHI)

Independent Variables (IV)	**n**	**Pearson Chi-square**	**P-value**
Household Food Security Status (FSCDDHFS)	26545	1079.9	<0.001*
Food Situation in Household (FSCD_010)	26683	939.3	<0.001*
Worried food would run out - 12 mo. (FSCD_020)	26666	984.3	<0.001*
Could not afford to eat balanced meals - 12 mo. (FSCD_040)	26657	1126.7	<0.001*

*statistically significant as values are under 0.01

Table 9b
Chi Square Tests between independent variables of interest and the dependent variable, Self perceived stress (GEND_07)

Independent Variables (IV)	**n**	**Pearson Chi-square**	**P-value**
Household Food Security Status (FSCDDHFS)	23881	576.2	<0.001*
Food Situation in Household (FSCD_010)	34894	16759.2	<0.001*
Worried food would run out - 12 mo. (FSCD_020)	23983	608.6	<0.001*
Could not afford to eat balanced meals - 12 mo. (FSCD_040)	23976	585.8	<0.001*

*statistically significant as values are under 0.01

Figure 2a

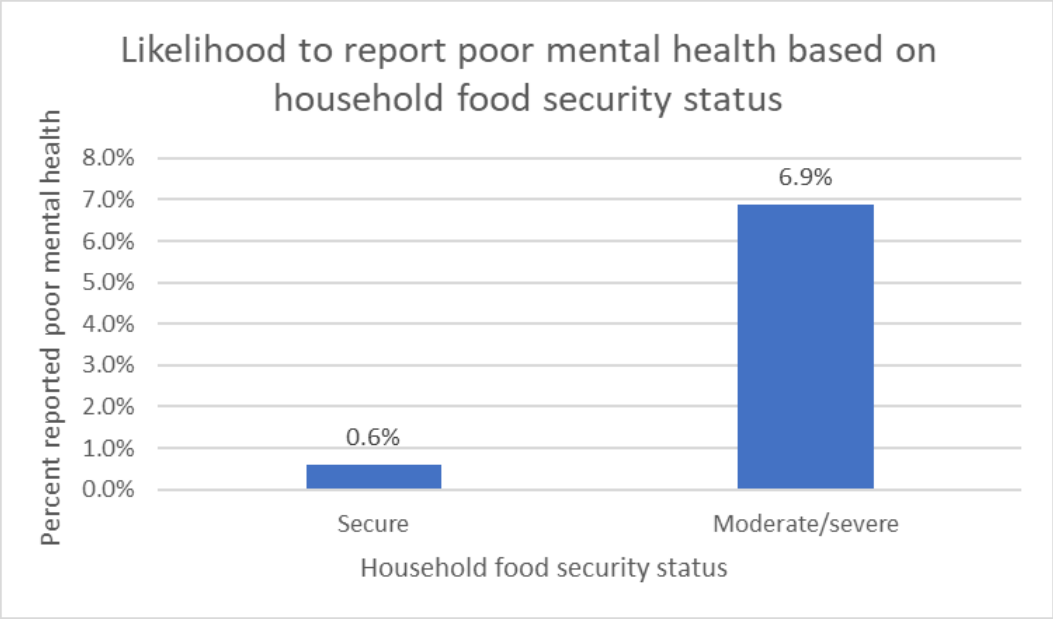


Figure 2b

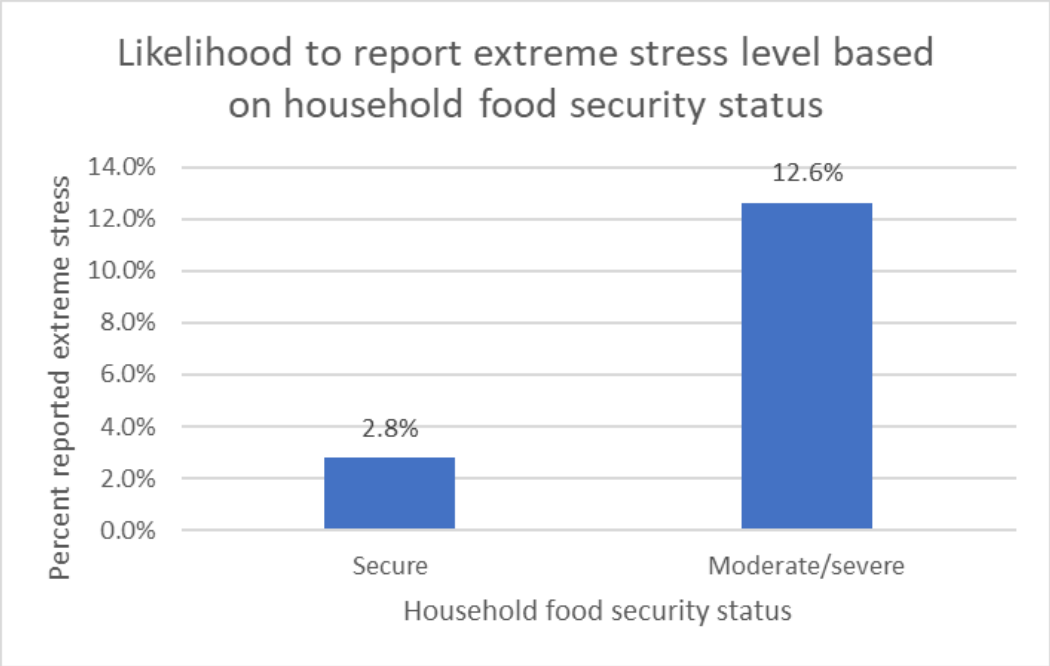


Table 10a
Pearson correlation and Bivariate Linear Regression to predict the dependent variable, Self-rated mental health (GENDDMHI)

Independent Variables (IV)	**Pearson Correlation**	**R^2**	**P-value**	**n**	**F**	**Interpretation**
Household Food Security Status (FSCDDHFS)	r = -0.169	2.9%	<0.001*	26545	781.2	
Food Situation in Household (FSCD_010)	r = -0.161	2.6%	<0.001*	26683	711.6	
Worried food would run out - 12 mo. (FSCD_020)	r = 0.168	2.8%	<0.001*	26666	774.0	
Could not afford to eat balanced meals - 12 mo. (FSCD_040)	r = 0.173	3.0%	<0.001*	26657	822.0	Highest R^2, which means it has the strongest predictive power in the change in the dependent variable

* The correlation is significant at the 0.01 level (2-tailed)

Table 10b

Pearson correlation and Bivariate Linear Regression to predict the dependent variable, Self perceived stress (GEND_07)

Independent Variables (IV)	**Pearson Correlation**	**R^2**	**P-value**	**n**	**F**	**Interpretation**
Household Food Security Status (FSCDDHFS)	r =0.138	1.9%	<0.001*	23881	464.9	
Food Situation in Household (FSCD_010)	r =0.146	2.1%	<0.001*	23994	523.9	Highest R^2, which means it has the strongest predictive power in the change in the dependent variable
Worried food would run out - 12 mo. (FSCD_020)	r = -0.137	1.9%	<0.001*	23983	458.464	
Could not afford to eat balanced meals - 12 mo. (FSCD_040)	r = -0.137	1.9%	<0.001*	23976	460.297	

* The correlation is significant at the 0.01 level (2-tailed)

Table 11a
Multiple Linear Regression Models to predict dependent variable, Self-rated mental health (GENDDMHI)

Model #*	IVs entered	n	R^2 (P value)	R^2 Change**	Standardized β (P value)***	Interpretations
1	IV_1 = Household food security status (FSCDDHFS)	26545	2.9% (<0.001)	-	β1 = -0.169 (<0.001)	
2	IV_1 plus IV_2 = Food situation in household - 12 mo. (FSCD_010)	26545	3.4% (<0.001)	+0.5%	β1 = -0.116 (<0.001) β2 = -0.093 (<0.001)	
3	IV_1 plus IV_2 plus IV_3 = Worried food would run out - 12 mo. (FSCD_020)	26545	3.7% (<0.001)	+0.8%	β1 = -0.068 (<0.001) β2 = -0.082 (<0.001) β3 = +0.072 (<0.001)	
4	IV_1 plus IV_2 plus IV_3 plus IV_4= Could not afford balanced meals - 12 mo. (FSCD_040)	26545	3.8% (<0.001)	+0.9%	β1 = -0.033 (<0.001) β2 = -0.073 (0.003) β3 = +0.059 (<0.001) β4 = +0.065 (<0.001)	Tied for strongest model IV_2 has the largest β
5	IV_2	26683	2.6% (<0.001)	-0.3%	β2 = -0.161 (<0.001)	
6	IV_2 plus IV_4	26657	3.6% (<0.001)	+0.7%	β2 = -0.092 (<0.001) β4 = +0.121 (<0.001)	
7	IV_2 plus IV_3	26666	3.5% (<0.001)	+0.6%	β2 = -0.1.00 (<0.001) β3 = +0.115 (<0.001)	
8	IV_1 plus IV_2 plus IV_4	26545	3.7% (<0.001)	+0.8%	β1 = -0.063 (<0.001) β2 = -0.079 (<0.001) β4 = +0.079 (<0.001)	
9	IV_2 plus IV_3 plus IV_4	26653	3.8% (<0.001)	+0.9%	β2 = -0.077 (<0.001) β3 = +0.073 (<0.001) β4 = +0.080 (<0.001)	Tied for strongest model Most efficient model

*The F values for every single model presented in this table were high with a p = <0.001
**R^2 change = R^2 of the model - R^2 of Model 1 (reference model)
*** P values of <0.05 are considered statistically significant

Table 11b
Multiple Linear Regression Models to predict dependent variable, Self-perceived stress (GEND_07)

Model #*	IVs entered	n	R^2 (P value)	R^2 Change**	Standardized β (P value)***	Interpretations
1	IV_1 = Household food security status (FSCDDHFS)	23881	1.9% (<0.001)	-	β1 = +0.138 (<0.001)	
2	IV_1 plus IV_2 = Could not afford balanced meals - 12 mo. (FSCD_040)	23881	2.1% (<0.001)	+0.2	β1 = +0.083 (<0.001) β2 = -0.072 (<0.001)	
3	IV_1 plus IV_2 plus IV_3 = Food situation in household - 12 mo.	23881	2.6% (<0.001)	+0.7	β1 = +0.051 (<0.001) β2 = -0.045 (<0.001) β3 = +0.089 (<0.001)	
4	IV_1 plus IV_2 plus IV_3 plus IV_4= Worried food would run out - 12 mo. (FSCD_020)	23881	2.7% (<0.001)	+0.8	β1 = +0.029 (0.015) β2 = -0.035 (0.001) β3 = +0.085 (<0.001) β4 = -0.044 (<0.001)	Tied for strongest model IV_3 has largest β followed by IV_4
5	IV_3	23994	2.1% (<0.001)	+0.2	β3 = +0.146 (<0.001)	
6	IV_3 plus IV_4	23983	2.6% (<0.001)	+0.7	β3 = +0.102 (<0.001) β4 = -0.082 (<0.001)	
7	IV_2 plus IV_3 plus IV_4	23973	2.7% (<0.001)	+0.8	β2 = -0.048 (<0.001) β3 = +0.088 (<0.001) β4 = -0.056 (<0.001)	Tied for strongest model IV_3 has the highest β followed by IV_4 Most efficient model
8	IV_2 plus IV_3	23976	2.5% (<0.001)	+0.6	β2 = -0.080 (<0.001) β3 = +0.100 (<0.001)	
9	IV_1 plus IV_3	23881	2.5% (<0.001)	+0.6	β1 = +0.081 (<0.001) β3 = +0.97 (<0.001)	

*The F values for every single model presented in this table were high with a p = <0.001
**R^2 change = R^2 of the model - R^2 of model 1 (reference model)
*** p values of <0.05 are considered statistically significant