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Exploring Food Insecurity and Its Relationships to Perceived Stress and Sleep Quality in Female Undergraduate Students

Zainah TK Abushanab
Brescia University, zainahshanab@gmail.com

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Thesis Advisor: Dr. Christine Tenk

Abstract

This study investigated whether students who scored high in Food Insecurity, would have higher levels of Perceived Stress and lower Sleep Quality. Additionally, this study sought to clarify different types of stressors and their individual contribution to Sleep Quality Risk and Subjective Mental Health. The sample consisted of 65 female undergraduate students at a university in London, Ontario. A Kendall's tau-b correlation analysis revealed a significant positive correlation between Food Insecurity and Sleep Quality Risk. A significant positive correlation was also found a significant, positive relationship between Food Insecurity and Perceived Stress. Additionally, a significant negative relationship was revealed between Perceived Stress and Subjective Mental Health and a significant negative relationship was also revealed between Sleep Quality Risk and Subjective Mental Health. Furthermore, a significant, positive relationship was found between levels of Stress in all five categories (Academic, Personal, Family, Financial & Future) and Perceived Stress. Lastly, Sleep Quality Risk was significantly, positively associated with levels of Stress in the Academic, Personal and Family Stress categories. Together, these findings suggests that there are many and complex relationships between Food Insecurity, Perceived Stress, Sleep Quality Risk, and Subjective Mental Health among female undergraduate students.

Keywords: food insecurity, perceived stress, sleep quality risk, subjective mental health, undergraduate

Exploring Food Insecurity and Its Relationships to Perceived Stress and Sleep

Quality in Female Undergraduate Students

Food Insecurity is defined as insufficient and inconsistent access to appropriate amounts of food that prevents leading a healthy and active lifestyle (Hines et al., 2021; Ryan et al., 2022). Food Insecurity is an ongoing threat to many Canadians as Food Insecurity negatively influences multiple aspects of life such as well-being, education, work, and general health (Health Canada, 2007). Importantly, Food Insecurity may be on the rise in Canada. Previous research has established that the rise of cost of living is the most likely predictor of Food Insecurity (Sriram & Tarasuk, 2016; Pirrie et al., 2020) and the most recent Statistics Canada numbers from 2022 show that consumer inflation reached a drastic 6.8% annual increase in April 2022 (Statistics Canada, 2022). This extreme rise in inflation has increased the general cost of living and nearly 3 in 4 Canadians report challenges in meeting day-to-day expenses including transportation, housing, clothing, and food (Statistics Canada, 2022). When asked, 43% of Canadians reported that they were most affected by the rise of food prices, which rose by 9.7%. This has been increasing the need, since June of 2020, for Canadians to access community organizations to obtain meals or food (Statistics Canada, 2022). Currently, 20% of Canadians report that they will be very likely or somewhat likely to use community food organizations in the next 6 months and young Canadians aged 15-29 are twice as likely to be concerned about their ability to afford the cost of living (Statistics Canada, 2022).

Within the general definition of Food Insecurity; as limited or uncertain availability of nutritionally adequate and safe foods, there are four different classifications of Food Insecurity based on severity. The first classification includes households that do not experience Food Insecurity and demonstrate no limitations in food access or availability (Statistics Canada, 2019).

These households are classified as food secure (Statistics Canada, 2019). The second classification is marginal food insecurity, considered to be the least severe type of Food Insecurity. This classification includes households that show some worry about running out of food and/or limited food selection due to financial restraint. The third classification of Food Insecurity is moderate food insecurity which involves reduced quantity and quality of food. The last and most critical degree of Food Insecurity is severe Food Insecurity which involves a significant reduction of food intake and disrupted eating patterns (Statistics Canada, 2019; Li et al., 2023).

In 2018, prior to the COVID-19 pandemic, 16.8% of all Canadians faced Food Insecurity (Statistics Canada, 2023). In the spring of 2020, during the early months of the COVID-19 pandemic, 14.6% Canadians reported Food Insecurity of some level. In the fall of 2020, at the height of the COVID-19 pandemic, 9.6% or 1 in 10 Canadians reported experiencing Food Insecurity of some level. While these statistics suggest a drop in food insecurity, these numbers reflect increased government assistance and increased funding to food banks and other organizations in order to offset increases in the number of people experiencing Food Insecurity over the course of the COVID-19 pandemic (Polsky, & Garriguet, 2022). The most recent Canadian statistics available indicate that in 2021, 18.4% of all Canadians across all 10 provinces faced food insecurity. (Statistics Canada, 2023).

One group that is especially vulnerable to Food Insecurity are young adults between the ages of 18 and 24. Young adults are especially vulnerable to Food Insecurity as they experience pivotal transitions psychologically, socially, and economically (PHAC, 2014; Bhawra et al., 2021). Prior to the COVID-19 pandemic, in 2018, 19.1% of the young adult Canadian population faced Food Insecurity (Statistics Canada, 2023). However, during the COVID-19 pandemic in

2019 and 2020, Food Insecurity decreased to 17.8% and 18% respectfully. The most recent statistics available indicate that in 2021, 19.8% of young adult Canadians faced food insecurity; a similar rate to Food Insecurity prior to the onset of the COVID-19 pandemic (Statistics Canada, 2023).

Further, young adults, especially those who are university or college students, are at a higher risk of experiencing Food Insecurity than the general population and are more likely to experience Food Insecurity towards the end of each academic semester (El Zein et al., 2018; El Zein et al., 2019). Indeed, some research suggests that Food Insecurity may be experienced by approximately one-third to one-half of post-secondary students (Bruening et al., 2017). In addition, food insecure college students are likely to be food insecure throughout adulthood and this is especially true when the students were economically/financially independent from their parents while in college (Leung et al., 2021). The high occurrence of Food Insecurity in post-secondary students highlights the need to investigate Food Insecurity experiences in Brescia University students.

The research surrounding gender differences in the occurrence of Food Insecurity is conflicting. Research evaluating the occurrence of Food Insecurity has highlighted a clear gender gap. For example, Jung et. al., 2017 conducted a meta-analysis of 153 articles and demonstrated that women are significantly more likely to report food insecurity. It was also shown that households with women as their head of household, were especially vulnerable to experiencing Food Insecurity in comparison to households headed by men. (Jung et al., 2017). Other research has also shown that females are more likely to experience Food Insecurity than males, especially females who are minorities (Walker et al., 2021). In addition, in a New Zealand based study, researchers examined Food Insecurity among those who are 15 years old or older (n=18,950).

They found that 19 % of females demonstrated food insecurity, while 12% of males demonstrated food insecurity (Carter et al., 2010). Based on these data points, researchers were able to conclude that females were more likely to experience Food Insecurity in comparison to their male counterparts (Carter et al., 2010). Given the increased likelihood of Food Insecurity in women, it is especially important to assess the prevalence of Food Insecurity at Brescia university college, Canada's only women's only university.

Food Insecurity may influence overall physical well-being and is related to a range of unfavorable health outcomes (Ryan et al., 2022). In adults, Food Insecurity is associated with a higher risk of obesity and being overweight, as well as a higher risk of type 2 diabetes (Hampton, 2007). Those who experience Food Insecurity are at a higher risk of hypertension, which is elevated blood pressure, as well as an increased risk of developing a cardiovascular disease (Liu & Eicher-Miller, 2021). In addition, those who face Food Insecurity are at a much higher risk of having chronic mental health problems (Tarasuk et al., 2022). Food Insecurity is also associated with infectious diseases such as HIV; in addition to weaker suppression of HIV virals (Bekele et al., 2018). Lastly, Adult Canadians experiencing high levels of Food Insecurity are at much higher risk of premature mortality (Men et al., 2020).

As Food Insecurity is associated with various physical health outcomes, there is also an influx of research that examines various relationships between Food Insecurity and mental health outcomes. Research indicates that Food Insecurity is associated with increased levels of anxiety, depression, and stress (Bruening et al., 2017; Chilton & Booth, 2007). In one study, researchers were able to identify and examine high or severe levels of Food Insecurity among six mental health outcomes: major depressive states within the last year, depressive thought within the last month, anxiety, affective disorders, suicidal ideations, as well as self-reported status of mental

health (Jessiman-Perreault, 2017; Nagata et al., 2019). Researchers found that severe levels of Food Insecurity are associated with a higher risk of reporting having any of the six mental health outcomes previously mentioned. Researchers hypothesized that this association between Food Insecurity and mental health outcomes could be explained by the highly stressful nature of Food Insecurity (Jessiman-Perreault, 2017).

Other research has shown that food insecure adolescents are at a higher risk of showing symptoms of depression, suicidal thoughts and ideations, substance abuse issues, and dysthymia (Poole-Di Salvo et al., 2016). Moreover, adolescents who are aware of the Food Insecurity in their households often experience depression and anxiety (McRell et al., 2022).

In addition to being related to poorer physical health, mental health, stress levels and sleep quality; Food Insecurity also impacts students' academic performance (Bruening et al. 2018; Maroto, 2013). Students with sleeping disorders are at a higher risk of having poorer academic performance (Gaultney, 2010). Also, students who are food insecure were also more stressed, depressed, anxious, and paid less attention in class (Smith, 2022). In addition, different durations of Food Insecurity influence academic performance differently. The academic performance of those who experience acute Food Insecurity might not be as strongly hindered as those with more chronic cases of Food Insecurity (Woerden et al., 2019). This means that those who face longer periods of time facing food insecurity, are more likely to face problems in relation to their education. It is therefore important to examine the experience of Food Insecurity of the young adult population of Brescia University students.

Importantly, the health outcomes of Food Insecurity in university students are more noticeable (Bruening et al., 2018). Food insecure young adults in a college in the US demonstrated increased feelings of anguish, perceived need for assistance, loneliness, and

engaging in self-injurious behavior (Oh et al., 2022). College and university students experiencing Food Insecurity show more depressed mood than their peers who are not food insecure (Bruening et al., 2018). One of the adverse health outcomes is that is very prominent among college and university students experiencing Food Insecurity is the heightened experience of stress (Bruening et al., 2018; Chilton & Booth, 2007). Researchers observed that university students with concurrent Food Insecurity are two times more at risk of being under stress (Bruening et al., 2018). Researchers also reported higher levels of Food Insecurity among students towards the end of the fall and winter semesters, a time when Perceived Stress due to final exams and assignments is also high suggesting the possibility of a bidirectional relationship between Food Insecurity and mental well-being. (Bruening et al., 2018). This implies that just as Food Insecurity contributes to the creation of mental health problems among young adults, mental health problems such as depression might actually lead younger adults to become food insecure (Nagata et al., 2019).

There are also associations between gender differences and mental well-being outcomes. For example, women present major depressive symptoms and post-traumatic stress disorders more commonly than men (Bangasser et al., 2018). Female college students are at a higher risk of reporting high levels of Perceived Stress (Graves et al., 2021). One study examined Perceived Stress among female and male medical students and found female students reported higher levels of Perceived Stress (Worley et al., 2019). In addition, female medical students were found to have increased levels of personal distress, burnout, as well as emotional exhaustions while their male peers did not (Worley et al., 2019). Given these potential important relationships, it is important to further explore the relationship between Food Insecurity and mental well-being in female undergraduate students.

Not only is Food Insecurity associated with stress, but it is also associated with poorer sleep quality (Alhasan et al., 2023). College students who are experiencing Food Insecurity were found to have poorer sleep quality (Ding et al., 2015; Smith, 2022). One study examined sleep quality by looking at sleep duration, complaints, and latency and were able to find significant relationships to Food Insecurity (Ding et al., 2015). Women with low food security were found to be sleeping less, whereas men did not show this link. However, other researchers found that men with Food Insecurity took longer times to fall asleep while women did not (Ding et al., 2015). Another study examining young adults' sleep outcomes found that Food Insecurity is associated with problems with falling asleep and staying asleep (Nagata et al., 2019). Another study examined a sample of undergraduate students (n=237) and reported significant impacts on sleep in students experiencing food insecurity. These students had trouble falling asleep, staying asleep, or sleeping too much (Payne-Sturges et al., 2018). Some research suggests that reducing Food Insecurity improves sleep and subsequently improves aspects of mental and physical health (Martinez et al., 2022).

The current study will examine the relationships between Food Insecurity and Mental health outcomes in first-year female undergraduate students at Brescia University College in post the pandemic of COVID-19. Levels of Food Insecurity at Brescia University College were not well understood and characterizing the prevalence, and gradient of Food Insecurity might help provide an indication of the occurrence of Food Insecurity at an all-women's university. In addition to levels of food insecurity, students' Perceived Stress levels and sleep quality will also be assessed in this study. The relationships among food insecurity, Perceived Stress, and sleep quality will be explored.

It is hypothesized that higher levels of Food Insecurity will be significantly, positively related to measures of Perceived Stress. It is also hypothesized that higher levels of Food Insecurity will be significantly, negatively related to sleep quality. This study is important for evaluating the experience of Food Insecurity in first-year female university students and examining the potential influences of these experiences on mental well-being.

Method

This study involved an online survey delivered through Qualtrics (Appendix A) that contained questions assembled from multiple questionnaires to examine food insecurity, stress, and sleep quality.

Participants

The study included 76 participants recruited from the Brescia University College student pool. Participants were recruited to participate in research studies as part of their PSY 1015B course, through information provided in the course outline and through announcements made by the instructor in class. Any students enrolled in PSY1015B Sec 530 or PSY1015B Sec 531 during the 2023-24 academic year at Brescia University College were eligible to take part in this study. Those who are not enrolled in these classes, were not eligible to take part in this study and therefore were excluded from participating. Participants were asked to self-determine their eligibility to participate.

Materials

<u>Demographic Questions</u>

Participants were asked to respond to up to 27 demographic questions that were designed to gather data on personal characteristics such as age, gender, and economic situation. These factors have been identified in prior research as relating to food insecurity and mental well-being

(Carter et al., 2010). Self-identified race and ethnocultural origins of participants were also

collected according to current Health Canada standards (Canadian Institute for Health

Information, 2022; Statistics Canada, 2020). Participants also responded to additional

sociodemographic questions such as income, level of education, and citizenship status; to further

understand factors that are related to food insecurity, perceived stress, and sleep quality in female

undergraduates.

Pittsburgh Sleep Quality Index (PSQI)

Participants then completed 18 questions about their sleep quality, using the Pittsburgh

Sleep Quality Index (PSQI; Buysse et al., 1989). Questions target 7 categories regarding sleep:

quality, duration, latency, habitual sleep efficiency, disturbances, daytime dysfunction, and any

use of sleeping medication. Fourteen questions from the PSQI are answered using a 4-point

Likert scale that ranges from "Not during the last month" to "Three or more times a week". An

example of this type of question from the PSQI is "During the past month, how often have you

had trouble sleeping because you feel too cold?". In addition, the PSQI includes 4 questions that

are answered with very short open-ended responses such as "During the past month, what time

have you usually gone to bed at night?".

Perceived Stress Scale (PSS)

Next, participants answered 14 questions about their perceived stress level, using the

Perceived Stress Scale (PSS; Cohen et al., 1983). This assessment uses a five-point Likert scale

ranging from "Never" to "very often" as participants answer questions about their perceived

stress such as, "In the last month, how often have you felt that things were going your way?". In

addition, participants were asked to list their top 3 stressors as well as rate the extent to which

they experience general stressors such as academic and family stress. An additional question

asked participants to describe the general nature of their mental health in order to measure their subjective mental health (Polsky & Gilmour, 2020).

<u>Food Insecurity Questionnaire</u>

Finally, participants completed questions about their experiences with food insecurity. First, participants completed the adult scale of the Household Food Security Survey Module (HFSSM; Health Canada, 2004). This is a three-stage survey, and participants progress through stages based on their responses, completing up to 10 questions. An example question is "You and other household members couldn't afford to eat balanced meals. In the past 12 months was that often true, sometimes true, or never true?". In addition, participants completed 3 additional questions including what barriers they face to access food, if they access meal support services, and if they follow a specific diet for health, cultural or religious purposes.

Procedure

In order to participate in this study, participants were required to log in to a Brescia SONA account where they were able to see the Study Description of this study (Appendix B) and other studies. If they were interested in participating, they selected this study. After making their selection, participants were automatically and anonymously redirected to the Qualtrics website. This is an entirely virtual process, and the study could be conducted from any place with dependable internet connection at any time that might suit them best.

Once the participants started the survey on Qualtrics, they were presented with a Letter of Information and Informed Consent (Appendix C), and participants chose "Yes" or "No" to provide consent after they reach the bottom of the LOI-C. Participants also needed to click the "Next" button in order to confirm their consent to participate. Participants were then presented

with the demographic questions, the PSQI, PSS and top 3 stressor question, and the HFSSM and food insecurity questions (Appendix A).

This survey was composed of up to 84 questions and did not take longer than 30 minutes to be completed. As soon as participants completed the survey, they were presented with the Debriefing Form (Appendix D) which thanked them for participating and provided them with information about the study as well as resources in the local community to improve their access to food as well as mental health resources.

Results

Before any data analyses were conducted, the data from participants whose survey completion duration was more than 3 times the mean completion duration (i.e. > completion duration longer than 13315.94s) were excluded. In addition, data from participants who identified their gender as different than 'female' were excluded. This resulted in the exclusion on an additional 2 participants leaving a total of 65 participants (n=65).

Characterizing Food Insecurity, Perceived Stress, and Subjective Mental Health

The first aim of this study was to characterize the experience of food insecurity in Brescia University students in addition to characterizing their experience of Perceived Stress, and Subjective Mental Health.

Figure 1 displays the percentage of participants in each of the four categories of Food Insecurity including Food Secure, Marginally Food Insecure, Moderately Food Insecure, and Severely Food Insecure. The majority of our sample fell into the Food Secure category (78%) with the remaining 22% of the sample reporting some degree of Food Insecurity

Figure 1

Levels of Food Insecurity
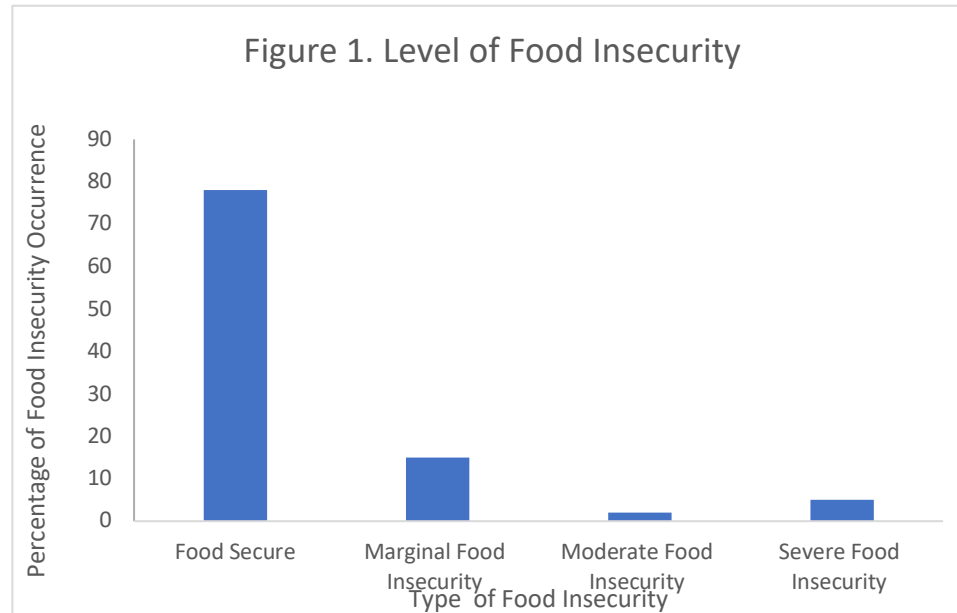
Note. *This figure demonstrates the percentage of participants reporting the different levels of food insecurity experienced by Brescia University College students. 78% of the sample fell into the Food Secure category with the remaining 22% of the sample reporting some degree of Food Insecurity*

A linear regression analysis was conducted to assess possible contributions of demographic variables including Age, Size of Economic Family, Program, Racial Background, Aboriginal Status, Citizenship Status, Domestic or International Student, Living Location, Family-Owned Dwelling, Income, Highest Level of Education of Self, Mother, and Father to the occurrence of Food Insecurity. This analysis yielded a significant model, $F (47, 17) = 2.86$, $p = 0.01$, $R^2 = .89$. Of the demographic variables, the significant predictors of Food Insecurity were Age ($\beta = -0.45$, $p = .03$) Fathers' Highest Level of Education ($\beta = -1.58$, $p = .04$).

Perceived Stress levels were reported as $M = 33.4$, $SD = 6.03$. Perceived Stress levels were compared with data obtained from different groups of participants collected during the

2020-21 and 2022-23 school years, through a one-way ANOVA test. Figure 2 displays current

Perceived Stress levels (2023-24) compared to those 2020-21 and 2022-23.

Figure 2

Levels of Perceived Stress Across Years
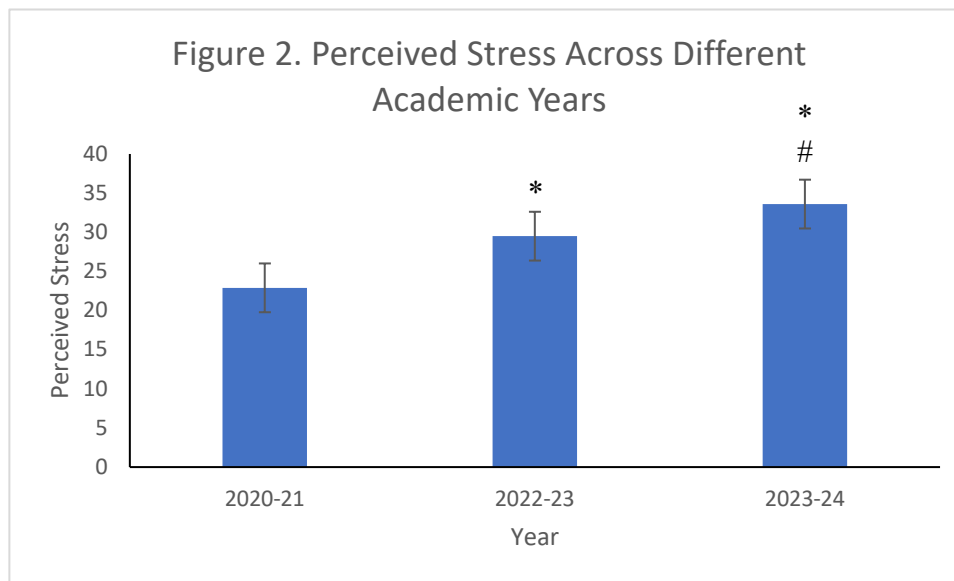
Note. *Height of bars indicate mean of Perceived Stress. Error bars represent SEM. Perceived*

Stress differed in Brescia University College students across multiple years. *p < .001;

significantly different from 2020-21. # p = .002 significantly different from 2022-23.

   A one-way ANOVA with between-subjects factor of Year (3 levels: 2020-21, 2022-23, &

2023-24) was conducted to probe for differences in levels of Perceived Stress across years. The

ANOVA revealed that there were significant differences in Perceived Stress levels among the

years, $F(2, 234) = 45.40$, $p < .001$, $\eta^2 = 0.28$. Tukey's Post Hoc tests indicated that participants

reported significantly higher Perceived Stress levels in 2023-24 than in 2022-23 ($p = .002$) and

then in 2020-21 ($p < .001$). Participants also reported higher Perceived Stress levels in 2022-23

than in 2020-21 ($p < .001$).

Levels of Stress in 5 different categories (Academic, Personal, Family, Financial & Future) were also collected. The mean level of Stress experienced in each of the 5 categories is shown in Figure 3.

Figure 3

Level of Stress Experienced in Different Categories of Stress

Figure 3. Levels of Stress for 5 Types of Stressors
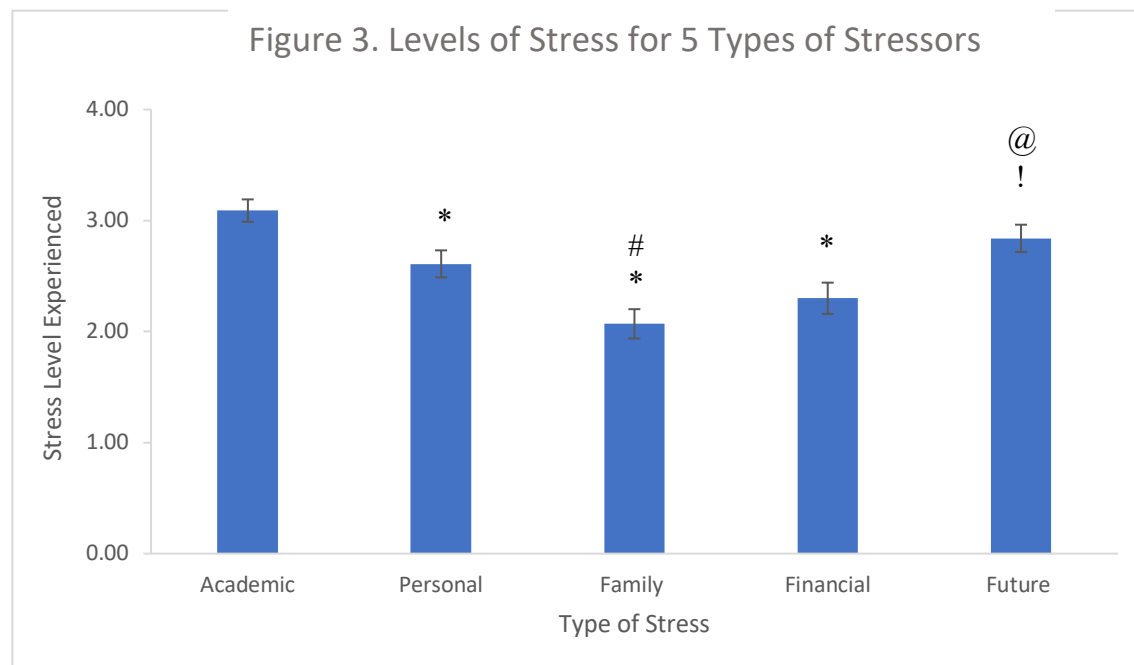
Note. *Height of bars indicate means. Error bars represent SEM. Levels of Stress differed significantly among the 5 types of stressors.. *p < .001 significantly different from Academic Stress. # p < .001 significantly different from Personal Stress. @ p < .001 significantly different from Family Stress.! p =.006 significantly different from Financial Stress.*

As shown in Figure 3, the highest levels of Stress were reported in the categories of Academic and Future Stress. Levels of Stress experienced in each category were reported as Academic $M = 3.08$, $SD = .84$; Personal $M = 2.58$, $SD = 1.00$; Family $M = 2.05$, $SD = 1.08$; Financial $M = 2.29$, $SD = 1.17$; Future $M = 2.82$, $SD = 1.01$. In order to determine if there were

statistically significant differences among the levels of reported Stress in each category, a

repeated measures ANOVA with within subjects' factors of Stress Category (5 levels: Academic,

Personal, Family, Financial, and Future) was conducted. The ANOVA revealed that there were

significant differences in Stress levels among the different types of stressors, $F (4, 256) = 15.10$,

$p < .001$, $n^2 = .11$.

Tukey's Post Hoc tests indicated that participants were significantly more stressed in

some stressors more than other. Tukey's Post hoc comparisons revealed that Academic Stress

was significantly higher that Personal Stress, Family Stress, and Financial Stress (p's $< .001$).

Personal Stress was found be significantly higher than Family Stress ($p < .001$) and Future Stress

was significantly higher than Family ($p < .001$) and Financial Stress ($p = .006$).

Subjective Mental Health was reported as $M = 1.17$, $SD = .84$. Figure 4 displays the

percentage of the sample falling into each of the 5 categories of Subjective Mental Health

including Poor, Fair, Good, Very Good, and Excellent. 23.1% of the sample reported having

"Poor" Subjective Mental Health, 41.5% of the sample reported having "Fair" Subjective Mental

Health, 30.8% reported "Good" Subjective Mental Health, 4.6% reported "very good" Subjective

Mental Health, and 0% reported "Excellent" Subjective Mental Health. This is shown in Figure

4.

Figure 4

Subjective Mental Health
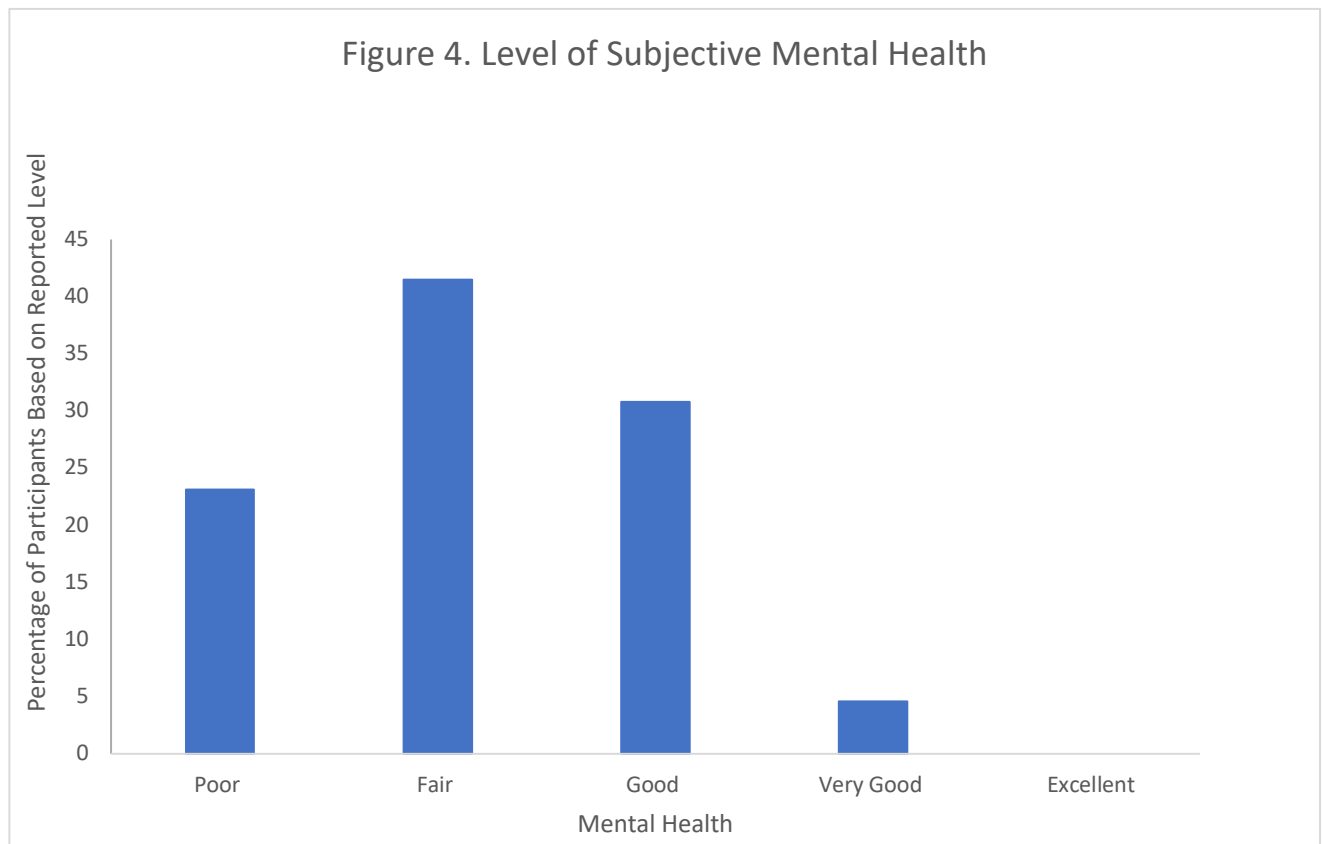
Figure 4. Level of Subjective Mental Health

Note. *This figure demonstrates the percentage of participants reporting the different levels of Subjective Mental Health experienced by Brescia University College students. 23% of participants reported having poor Subjective Mental Health, while 77% of participants reported having some degree of "positive" Subjective Mental Health.*

Relationship Among Food Insecurity and Sleep Quality Risk

The relationship between participants' level of Food Insecurity and their Sleep Quality Risk was evaluated using Kendal's Tau correlational analyses.

However, contrary to our hypothesis, there was no significant correlation found between food insecurity and Sleep Quality Risk $r (65) =. 02, p = .86$.

Further correlational analysis was conducted to probe for relationships among Food Insecurity and the seven individual components of the Sleep Quality Risk index. This analysis yielded a significant, positive correlation between Food Insecurity and Subjective Sleep Quality. As Food Insecurity increases, so does poorer Subjective Sleep Quality (See Table 2).

Table 2

Relationships among Food Insecurity and Individual Components of Sleep Quality Risk Index

	Subjective Sleep Quality	Sleep Latency	Sleep Duration	Sleep Efficiency	Sleep Disturbance	Use of Sleep Medication	Daytime Dysfunction
Food Insecurity	$r=.24$ $p=.04$	$r=.07$ $p=.51$	$r= -. 05$ $p= .66$	$r= -. 13$ $p= .15$	$r= .06$ $p=. 61$	$r= -. 16$ $p= .16$	$r=.10$ $p= .34$

Note. *Correlations among Food Insecurity and the seven individual components of Sleep Quality Risk. Table demonstrates a lack of significant correlations.*

Relationships among Food Insecurity, Sleep Quality Risk, Perceived Stress

To probe for possible relationships among Food Insecurity, Sleep Quality Risk, and Perceived Stress, a Kendall's tau-b correlational analysis was conducted. This analysis revealed a significant, positive relationship between Food Insecurity and Perceived Stress, $r (65) = .23, p = .03$. As Food Insecurity increased, so did Perceived Stress. A trend toward a significant, positive relationship was found between Perceived Stress and Sleep Quality Risk was found, $r (65) = .18, p = .05$. However, the correlational analyses revealed no significant relationship between Sleep Quality Risk and Food Insecurity.

Given these significant correlations, a linear regression analysis was performed to see if

Food Insecurity was predictive of Perceived Stress. A significant portion of the variance in

Perceived Stress scores, 7%, was accounted for by Food Insecurity score, $R^2 = .07$, $F (1, 63) =$

4.47, $p = .04$. Therefore, a participant's Food Insecurity score was a significant predictor of their

Perceived Stress score. A linear regression analysis was also performed to see if Sleep Quality

Risk was predictive of Perceived Stress. A portion of the variance in Perceived Stress scores,

7%, was accounted for by their Sleep Quality Risk score, $R^2 = .07$, $F (1, 63) = 4.78$, $p = .04$.

Therefore, a participant's Sleep Quality Risk score was a significant predictor of their Perceived

Stress score.

Relationship Among Food Insecurity, Sleep Quality Risk, Perceived Stress, and Subjective

Mental Health

A Kendall's Tau correlational analysis was conducted to explore possible relationships

among Subjective Mental Health, Perceived Stress, and Food Insecurity. A significant negative

relationship was revealed between Perceived Stress and Subjective Mental Health, $r (63) = -.52$,

$p<.001$. . A significant negative relationship was also revealed between Sleep Quality Risk and

Subjective Mental Health, $r (63) = -.29$, $p=.004$. As Sleep Quality becomes worse, so does

Subjective Mental Health. No significant relationship was found between Food Insecurity and

Subjective Mental Health, $r (63) = -. 20$, $p = .09$.

As discussed earlier, Food Insecurity and Sleep Quality Risk significantly predict 18% of

the variance in Perceived Stress.

Given the significant correlations, a linear regression analysis was also performed to

examine whether Sleep Quality Risk, or Perceived Stress significantly predicted Subjective

Mental Health. This regression analysis yielded a statistically significant model $R^2 = .43$, F (2,

62) = 23.30, $p = < .001$. The R^2 value   of 0.43 associated with this model indicates that

together Sleep Quality Risk, and Perceived Stress accounted for 43% of the variance in

Subjective Mental Health. Perceived Stress was found to significantly predict Subjective Mental

Health ($\beta = -.57$, $p < .001$). Sleep Quality Risk trended toward significantly predicting Subjective

Mental Health ($\beta = -.20$, $p = .04$).

Relationships of Reported Levels of Stress Among Stressors and Perceived Stress

A Kendall's Tau correlational analysis was conducted to explore the relationships

between levels of stress in different categories and Perceived Stress. As shown in Figure 3, A

significant, positive relationship was found between levels of Stress in all five categories and

Perceived Stress. These significant correlations were found to be. Academic Stress r (63) = .36, p

<.001. Personal Stress r (63) = .30, p = .002. Family Stress r (63) = .26, p =.0047 Financial stress

r (63) = .22, p =.02. And finally Future Stress r (63) = .23, p = .02. As level of Stress in each

category increased, so did Perceived Stress.

Given these significant correlations, a linear regression analysis was performed to explore

whether Academic, Personal, Family, Financial or Future Stress significantly predict Perceived

Stress. The results of the analysis revealed a statistically significant model, $R^2 = .31$, F (5, 59) =

5.30, p = <.001. The R^2 value of 0.31 associated with this model indicates that together stress

experienced in the 5 categories accounted for 31% of variance in Perceived Stress. It was found

that Academic Stress significantly predicted Perceived Stress ($\beta = .35$, $p = 007$). No other

categories of stress significantly predicted Perceived Stress

Relationships Among Levels of Stress in Different Categories, Sleep Quality Risk and

Subjective Mental Health

A correlational analyses using Kendall's tau-b was conducted to examine the

relationships among Stress levels in different categories, Sleep Quality Risk and Subjective

Mental Health. The results of this analysis are displayed in Table 3. Sleep Quality Risk was

significantly, positively associated with levels of Stress in the Academic, Personal and Family

Stress categories. As Stress in these categories increases, Sleep Quality Risk decreases.

Subjective Mental Health was significantly, negatively associated with levels of Stress in the

Academic, Personal, and Family, Stress categories. Future Stress trended toward a significant,

negative association with Subjective Mental Health. As Stress in these categories increases,

Subjective Mental Health decreases.

Table 3

Relationships among Stress Levels to 5 Types of Stressors, Sleep Quality Risk and Subjective

Mental Health

	Sleep Quality Risk	Subjective Mental Health
Academic Stress	$r=.29**$ $p=.004$	$r=-.26*$ $p=.02$
Personal Stress	$r=.28**$ $p=.004$	$r=-.36***$ $p<.001$
Family Stress	$r=.21*$ $p=.03$	$r=-.30**$ $p=.005$
Financial Stress	$r=.07$ $p=.45$	$r=-.16$ $p=.13$
Future Stress	$r=.08$	$r=-.21$

	p=.43	p=.06

Note. *This table demonstrates the relationships between Stressors, Sleep Quality Risk, and Subjective Mental Health among female undergraduate students. Financial Stress is not significantly correlated with Sleep Quality Risk nor Subjective Mental Health.*

[1]*p < .05, **p < .01, ***p< .001*

Given these significant correlations, a linear regression analysis was performed to explore whether Academic, Personal, or Family Stress significantly predict Sleep Quality Risk. The results of the analysis revealed a statistically significant model, $R^2 = .20$, $F(3, 61) = 5.19$, $p = .003$. The R^2 *value* of 0.20 associated with this model indicates that together Academic, Personal, and Family Stress accounted for 20% of variance in Sleep Quality Risk. It was found that Academic Stress significantly predicted Sleep Quality Risk ($\beta = .29$, $p = .02$). Personal Stress also significantly predicted Sleep Quality Risk ($\beta = .26$, $p = .04$).

A separate linear regression analysis was also performed to explore whether Academic, Personal, Family, or Future Stress significantly predict Subjective Mental Health. The results of the analysis revealed a statistically significant model, $R^2 = .26$, $F(4, 60) = 5.31$, $p < .001$. The R^2 *value* of 0.28 associated with this model indicates that together Academic, Personal, Family and Future Stress accounted for 28% of variance in Subjective Mental Health. It was found that Personal Stress significantly predicted Subjective Mental Health ($\beta = -.30$, $p = .02$). No other significant predictors were found.

Discussion

Summary of Results

The first aim of this study was to characterize the experience of food insecurity as well as explore the relationships among Food Insecurity, Stress and Subjective Mental Health in female Brescia University students. In terms of Food Insecurity, the majority of our sample fell into the Food Secure category (78%) with the remaining 22% of the sample reporting some degree of Food Insecurity. Further, Age and Father's Education Levels were identified as significant predictors. This highlighted Parental socioeconomic status and student's Age on Food Security. It was then found that Perceived Stress varied across academic years, with students in the 2023-24 reporting the highest levels of Perceived Stress. Explorations of Stressors revealed that Academic and Future stressors had higher levels of Stress compared to Personal, Family, and Financial Stress. This demonstrated the significance of Academic-related pressures on students' overall levels of Perceived Stress. Measures of Subjective Mental Health reviled that a significant portion of the participants have Poor Mental Health. Examining the connections between Food Insecurity, Perceived Stress, Sleep Quality Risk, and Subjective Mental Health has several significant findings. While no significant correlation was found between Food Insecurity and Sleep Quality Risk, we found a positive correlational relationship between Food Insecurity and Perceived Stress. Seep Quality Risk was significantly correlated with Subjective Sleep Quality, which is one component of 7 from the Sleep Quality Risk Index.

Food Insecurity

As previously explained, Food insecurity is an insufficient and inconsistent access to appropriate amounts of food that prevents leading a healthy and active lifestyle (Hines et al., 2021; Ryan et al., 2022). Post-secondary Canadian students are especially susceptible to

experiencing food insecurity (Maynard et al., 2018). In a Canadian based study, Maynard and colleagues found that of their sample (n=14; range 19 – 25 years old) 7% of participants reported marginal food insecurity, 42% experienced moderate food insecurity and 25% of participants experienced severe food insecurity. Data by Maynard et al. (2018) show higher levels of food insecurity in post-secondary students than shown in our data and in other data. Our sample (n=65; range 18 – 24 years old) showed 15% of participants reported experiencing marginal food insecurity, 1% of participants reported moderate food insecurity, 6% of participants were severely food insecure, while the rest of the sample (78%) was food secure. Similarly, Tarasuk et al. (2018) reported the prevalence of household food insecurity in a very large study sample (n =80932; range 18 – 64 years old) was 12.1%, with 3.7% marginally food insecure, 5.2% moderately food insecure, and 3.1% severely food insecure. Tarasuk et al. (2023) reported the prevalence of household food insecurity in adolescents (n =8416, range 12 – 17 years old) was 21%. The difference among studies suggests that Food Insecurity varies among different age groups in Canada and requires further study to fully understand the experience of Food Insecurity in Canada's post-secondary and young adult populations.

Predictor of Food Insecurity – Fathers' Education & Age

In prior research, financial difficulties were the most common predictive factor of Food Insecurity, as finances and income can limit access to food (Burley & Awed, 2015). We were not able to find this relationship demonstrated within our sample. In our sample, Fathers' Highest Level of Education and Age significantly negatively predicted food insecurity. As Fathers' Highest Level of Education and Age increased, reports of food insecurity decreased. We speculate that education level of students' father likely reflect financial stability of the family since educational attainment predicts financial stability and long-term earnings (e.g. Tamborini

et al., 2015). This current study also found Age as a significant negative predictor of Food

Insecurity. This indicates that as Age increases, Food Insecurity decreases. The existing literature

on the relationship between food insecurity and age is mixed and inconsistent (Eicher-Miller &

Zhao, 2018). It has been suggested, through limited research, that the relationship between Food

Insecurity and Age is complex and not well understood; and depends on multiple factors such as

Health and socio-economic factors (Eicher-Miller & Zhao, 2018). The absence of other

significant predictors of Food Insecurity in the current study may be due to our small sample size

(n=65).

Food Insecurity and Sleep Quality Risk

The current study did fully support the hypothesis that Food insecurity would be

significantly related to poor sleep. No significant relationship was food between reported levels

of Food Insecurity and overall risk for poor Sleep Quality. However, this study did find a

significant relationship between reported levels of Food Insecurity and Subjective Sleep Quality,

whereas Food Insecurity increases, Subjective Sleep Quality decreased. These data contrast.

Prior research has also found a relationship between reported Food Insecurity poor sleep

quality where undergraduate students reporting Food Insecurity a have poorer sleep Quality

(Ding et al., 2015; Smith, 2022). Other research has also demonstrated similar findings. One

Study found that Participants with higher rates of Food Insecurity report sleeping less, have a

poorer sleep efficiency, and poorer Subjective Sleep Quality overall (Troxel et al., 2020). Other

research has found the same relationship where Food Insecurity was a significant predictor of

Sleep Quality Risk; categorizing it as a public health problem that is often overlooked (Wang,

2021).

Perceived Stress

On average, female Brescia University College students were significantly more stress in 2023-24 than in previous years. One may speculate that this increase in reported Perceived Stress could be attributed to Brescia's closure as an institution. However, in the current study, participants were asked to rate the level of stress experienced in each of 5 categories of Stress (Academic Stress, Personal Stress, Family Stress, Financial Stress, and Future Stress); Academic Stress was the most significant predictor of Perceived Stress among Brescia students, followed by Personal Stress and Future Stress. Academic Stress being the most Predictive of Perceived Stress is consistent with other findings, where one study reported that students in general have higher levels of stress when compared to the general population (Ebrahim, 2016). Similarly, Academic pressures were found to be a significant predictor to increased rates of Perceived Stress among nursing students (Luo & Wang, 2009).

Increased levels of stress in female Brescia students may also result from other factors including the long-term consequences of the COVID-19 pandemic. For example, one study found that students developed Stress almost 1 year after the pandemic has begun (Marcén-Román et al., 2021). Further, being female as well as being a student in their last year student, were found to be significant predictors of Perceived Stress (Marcén-Román et al., 2021). Another research article concluded that COVID-19 exacerbated concerns of mental health disorders and intensified levels of Perceived Stress in the post- COVID era (Dave et al., 2024). Importantly, the long-term effects of the COVID-19 Pandemic are still not fully understood and there needs to be furthered research conducted to address this gap.

Food Insecurity was also found to be a significant predictor of Perceived Stress, such that when Food Insecurity levels increase, so will levels of Perceived Stresses. This finding is consistent with our hypothesis and is consistent with other findings in the literature, where higher

levels of Food Insecurity and Perceived Stress were found in Syrian refugees in Canada (Zangiabadi et al., 2024). Moreover, students who are Food Insecure are far more Stressed and paid less attention in class, contributing more to Perceived Academic Stress (Smith, 2022).

We were able to conclude that food insecurity significantly predicted Perceived Stress. This means that as Food insecurity levels Increase, so will their scores of Perceived Stress. Researchers observed that university students with concurrent Food Insecurity are two times more at risk of being under stress (Broening et al., 2018).

Research suggests that the relationship between Food Insecurity and Perceived Stress is bidirectional (Bruening et al., 2018). Undergraduate students, such as those of Brescia's who experience Food Insecurity are two times more at risk of being under Stress (Bruening et al., 2018). At the same time, undergraduate students report higher levels of Food Insecurity towards the ends of the Academic Semester; a time that Perceived Stress is increased (Bruening et al., 2018). Some research suggests that Food Insecurity is highly associated with Mental Illness, and elevated levels of Stress exacerbate the risk of developing Mental Health disorders.

Individuals who report experiencing Food Insecurity face a heightened susceptibility to Mental Health Disorders (Martin et al., 2016). This elevated vulnerability is particularly amplified in environments characterized by elevated stress levels (Martin et al., 2016). This suggests that not only does Food Insecurity play a role in increasing the risk of Mental Health issues in young adults, but Mental Health problems like depression could also push a young adult into experiencing Food Insecurity (Nagata et al., 2019).

Additionally, Sleep Quality Risk was also found to be a *trending* towards being a significant predictor of Perceived Stress but was not statistically significant. Thus, the current findings do not align with prior research where researchers demonstrated that poorer sleep

quality was a significant predictor of Perceived Stress in medical students (Almojali et al., 2017). The lack of this significant finding in the current study again highlights the need for a larger sample to capture the relationship between Perceived Stress and Sleep Quality Risk that has been demonstrated in prior research.

Subjective Mental Health

In this current study, Food Insecurity was not significantly related to Subjective Mental Health. These findings are not consistent with the existing literature on the topic of Food Insecurity and Subjective Mental Health. There is an abundance of literature demonstrating how Food Insecurity is a significant predictor of Subjective Mental Health; those with levels of Food Insecurity are at a greater risk of having long term Mental Health issues (Tarasuk et al., 2022). One study asked participants to self-report their levels of Mental Health and found that there was a higher risk of reporting Mental Health Outcomes as Food Insecurity levels increased (Jessiman-Perreault, 2017). Prior research also has well established that Food Insecurity is associated with increased levels of anxiety, depression, and stress (Bruening et al., 2017; Chilton & Booth, 2007).

Our study failed to identify the lack of a significant relationship between Food Insecurity and Subjective Mental Health likely again reflects a sample size that was too small or may be due to the fact that this study's tool to measure Subjective Mental Health was a singular question. This single question may not have been the most comprehensive tool to capture participant's actual levels of Subjective Mental Health.

Sleep Quality Risk trended toward significantly predicting Subjective Mental Health but was not significant. The findings of this study are not consistent with previous research as research has shown a relationship between various Mental Health outcomes and Sleep Quality

Risk. One study found a significant correlation between Sleep Quality, Anxiety, and Depression; where Anxiety and Depression increase as Sleep Quality decreases (Ahammed et al., 2021). Other research studies have found similar relationships, Nursing students demonstrate a negative correlation between Depression and Sleep Quality (Augner, 2011; Mayers et al., 2009). This current study has failed to show this significance, but it was trending towards significance. This is indication that our sample size (n=65) was not large enough to capture this variance.

This study found that Perceived Stress significantly predicted Subjective Mental Health, as perceived stress increased, an individual's rating of their mental health decreased. This aligns with prior research in the field, undergraduate students who are under any level of Perceived Stress have an increased risk of having Mental Health problems (Holland, 2016). This pattern is also shown in Canadian undergraduate students as Stress has been shown to negatively affect their Mental Health (Ontario University & College Health Association [OUCHA], 2009). Undergraduate students who experience Perceived Stress are at risk of burnout, fatigue lead burnout, and mood disturbances; all of which can be grouped into the Mental Health umbrella (Salanova et al., 2009). Research has demonstrated that the relationship between Mental Health and Perceived Stress is bidirectional; as in having Mental Health Problems generates Stress and vice versa (Lavoie & Douglas, 2012).

In this current study, Subjective Mental Health was significantly, negatively associated with levels of Personal Stress. One study looked at Medical Students' experience of Personal Stress and Academic Stress and how they could be a predictor of Depression (O'Reilly et al., 2014). Researchers found Academic Stress and Personal Stress both significantly predicted Depression; with Academic Stress being far more significant (O'Reilly et al., 2014). In this study, only Personal Stress was a significant predictor of Subjective Mental Health.

The Difference Between Subjective Mental Health and Perceived Stress

Interestingly, this study highlighted an apparent distinction between Subjective Mental Health and Perceived Stress as they seem to be different constructs. In the current study, while these constructs are significantly related, such that as perceived stress increases, ratings of subjective mental health go down, these two constructs are clearly predicted by different factors. Perceived stress is significantly predicted by higher levels of food insecurity, poorer sleep quality and higher academic stress. Subjective mental health, however, is only significantly predicted by levels of personal stress.

Implications

This study has important implications. First, it is important to note that Brescia University College is closing at the end of the 2023/24 academic year; this data would have been useful if Brescia was not shutting down forever as it would have provided them with a better understanding on what Food insecurity actually looks like on their campus. However, these results are still relevant as they are a good indication of Food Insecurity in female undergraduate students. Another implication of this study is the need to develop intervention to tackle students' Stress levels; especially the three most reported stressors (i.e. Academic, Personal, and Family Stress) that is because Perceived Stress is a predictor of Food Insecurity. An Additional implication is to develop interventions and programs that tackle student's Mental Health as Perceived Stress predicts Subjective Mental Health in female undergraduate students.

Limitations

While this study provides a valuable insight into the relationships between Food Insecurity, Perceived Stress, Sleep Quality Index, and Subjective Mental Health, there are limitations. First, the study was conducted in a Women's only University, and limits the

generalizability of the findings to other student populations or demographic groups. Additionally, we had a small sample size and likely limited our statical power identify weaker effects. An addition limitation is specific to the Subjective Mental Health Measure which was made of a singular question "In general, how would you describe your mental health". This singular question is not a very comprehensive tool for depicting the Subjective Mental Health of our Participants. Additional research employing a larger and more diverse sample size is needed to explore all possible relationships among Food Insecurity, Perceived Stress, Sleep Quality Index, and Subjective Mental Health. Subjective Mental Health should be looked at through more comprehensive tools such as the Psychological Well-Being Scale.

Conclusions of Discussion

In conclusion, this study demonstrated significant associations between Food Insecurity, Perceived Stress, Sleep Quality, and Subjective Mental Health among female undergraduate students. As we hypothesized Food Insecurity was found to be a significant predictor of Perceived Stress. This means that as Food Insecurity levels increase, so will levels of Perceived Stress. However, contrary to what we hypothesized there was limited significant relationships between Food Insecurity and poor Sleep Quality. Importantly, we also identified that female undergraduate students are reporting higher perceived stress levels than during the 2020-21 and 2022-23 academic years. The areas of highest stress for female undergraduate students were Academic Stress, Personal Stress, and Future stress. Higher Academic Stress significantly predicted higher Perceived Stress while higher Personal Stress significantly predicted lower Subjective Mental Health. This study provides preliminary characterization of food insecurity at an all-women's university and provides areas important to target to reduce Perceived Stress and improve Subjective Mental Health in female undergraduate students.

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