Food Security in the OHSU Student Population before and during the COVID-19 Pandemic

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CERTIFICATE OF APPROVAL

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LIST OF ABBREVIATIONS

Abbreviation	Term
COVID-19	Coronavirus
BMI	Body Mass Index
CDC	Centers for Disease Control and Prevention
NHANES	National Health and Nutrition Examination Survey
OHSU	Oregon Health & Science University
PHQ-8 or PHQ-9	Patient Health Questionnaire
TANF	Temporary Assistance for Needy Families
USDA	United States Department of Agriculture
US HFSSM	USDA Household Food Security Survey Module
SNAP	Supplemental Nutrition Assistance Program
WIC	Women, Infants and Children

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ABSTRACT

Food insecurity is prevalent among students enrolled in institutions of higher education and can result in academic and health consequences. The coronavirus (COVID-19) pandemic led to a state-wide closure of public spaces, known as the shelter-at-home mandate, and an urgent need to assess food security status among students. As such, the goals of this project were to assess food security status, use of university and community food resources, and use of response behaviors and coping strategies by students before and during the COVID-19 pandemic.

To achieve these goals, changes in food security status and university and community food resource use were assessed among a sample of health professional and graduate students enrolled at Oregon Health & Science University (OHSU). A cross-sectional survey was disseminated to assess food security status 12-months before and 2-3 months after the shelter-at-home mandate using the validated USDA Household Food Security Survey Module 6-Item Short Form. Questions pertaining to use of response behaviors and coping strategies and a free response question were included at the end of the survey. McNemar's tests or chi-square/Fisher's exact tests were used to determine differences in food security status and resource use before and during the pandemic and associations with sociodemographic factors, respectively. Two-sample, two-sided tests of proportions were used to assess differences in response behaviors and coping strategies among those who were food insecure and those who were food secure. Qualitative analysis using inductive coding of student responses was used to determine how OHSU could better support students who were food insecure.

Of the 175 students who completed the survey and were included in the analysis, the same proportion of students were food insecure before (27.4%) and during (27.4%) the pandemic. Compared to estimates of food insecurity among OHSU students in 2018, which was 28.5%, prevalence of food insecurity before and during the pandemic was not significantly different ($p=0.7650$). There was no difference in change in prevalence of food security status among those who became food insecure (3.4%) or became food secure (3.4%) after the shelter-at-home mandate ($p>0.05$). Use of any OHSU food resource ($p<0.001$), but not community resource ($p=0.0636$), was significantly lower after the shelter-at-home mandate than before. After the shelter-at-home mandate, there was a significantly higher proportion of students who were food insecure than food secure ($p<0.001$) who reported response behaviors and coping strategies including food-related stress, purchasing foods of reduced quality, having difficulty accessing non-food resources, leaving the home less often which increased the amount of food needed, being likely to use a prospective on-campus food pantry and feeling reduced motivation to cook healthy ($p=0.0398$). Qualitative analysis determined food access, food availability, and food preparation infrastructure at OHSU to be common themes that contributed to reduced food insecurity among students.

In conclusion, student food insecurity at OHSU during the pandemic was high and was related to limited access to food and resources on campus with a possible trend towards an increase in accessing community food resources. Additionally, use of response behaviors and coping strategies were higher among students who were food insecure than food secure. The findings reinforce the need to support students during crisis events. Providing access to healthy foods under these stressful conditions will allow students to focus on their health, wellness and overall academic success.

CHAPTER 1: INTRODUCTION AND SPECIFIC AIMS

Food insecurity, or the limited or uncertain availability of nutritious food that is safe for consumption, currently affects over 10% of the United States population.[1] Students enrolled in institutions of higher education are a vulnerable subgroup of the population that experiences food insecurity at even higher proportions. A recent meta-analysis estimated the weighted food insecurity prevalence among students enrolled in institutions of higher education to be 41%.[2] In 2018, 28.5% of health profession students at Oregon Health & Science University (OHSU) were classified as food insecure, which is comparable to the prevalence of food insecurity among students enrolled in other academic institutions.[3-6] Limited income, cost of education, current and previous student debt, and limited financial support are common risk factors contributing to the high prevalence of food insecurity within this population.[7] To address high rates of food insecurity among students, common university-based resources include food pantries, meal vouchers, and student discounts at retail food outlets.[8,9] OHSU has enacted interventions to reduce food insecurity among its student population including emergency meal kits, student meal discounts, and a local and university-based Food Resource Guide. However, access to these university resources was limited during the 2020-2012 Coronavirus global pandemic and the resulting shelter-at-home mandate.

Coronavirus, known as COVID-19, is defined by the World Health Organization as a novel virus that presents in humans as a respiratory illness that is spread between individuals mostly through saliva and respiratory droplets.[10] Due to the highly contagious nature of this virus and the associated high rates of morbidity and mortality, measures to reduce its spread prompted nation-wide closure of non-essential businesses and academic institutions to establish and

enforce precautionary practices including "physical distancing." Physical distancing is defined by the Center for Disease Control and Prevention (CDC) as reduced "face-to-face" interaction and meetings containing large groups.[11-13] In Oregon, this led to a state-wide closure of all public spaces known as the shelter-at-home mandate. With the closure of businesses and the enforcement of "physical distancing," millions of individuals in the United States lost their jobs, unemployment rates increased and, as a result, many filed for unemployment since March 2020.[14] The COVID-19 pandemic greatly impacted the United States and international economies, individual and household finances, and the ability of students to access university resources and support services including lower cost food.

Limited income and access to university campuses among students meant that many experienced heightened financial hardships and as a result, food insecurity. Students in higher-education environments are known to be at higher risk for experiencing food insecurity, which can affect diet quality, academic performance, and mental and physical health.[5,15-17] Despite these challenges, little is known about how this pandemic impacted food insecurity among college and university student populations.

The goal of this cross-sectional study was to determine the prevalence of food insecurity before and during the COVID-19 pandemic among the OHSU student population and their use of resources to access sufficient amounts of healthy food. Understanding the changes in food security status and food resource use will help to inform strategies to better support students during national, regional and local emergencies when access to resources on university campuses may be limited. The aims of this study were to test the following hypotheses.

Aim 1: Describe the prevalence of food insecurity among the OHSU student population before and during the COVID-19 pandemic between March and June of 2020.

Hypothesis 1a: A significant change in food security status will be seen with more students becoming food insecure, defined using the US HFSSM 6-item short form, after than before the shelter-at-home mandate was enacted in March 2020.

Hypothesis 1b: A significant association will exist between change in food security status and sociodemographic factors including age, gender, ethnicity, race, children in the home, marital status, household income, current length in program, tuition waiver, and international student status.

Aim 2: Compare the prevalence of food insecurity among OHSU students who responded to the survey administered in the Spring-Fall of 2020 to OHSU students who responded to a similar survey in the Spring of 2018 and to estimates of national food insecurity prevalence.

Hypothesis 2: There will be a significant difference in percentage of OHSU students classified as food insecure by the US HFSSM 6-item short form in 2020 than in 2018 and the current 2019 national household food insecurity prevalence.

Aim 3: Determine the use of university and community resources that assist with food access by the OHSU student population.

Hypothesis 3a: The percentage of OHSU students who started to use at least one community resource after the shelter-at-home mandate will be significantly higher than the percentage of OHSU students who stopped using any community resource after the shelter-at-home mandate. The percentage of OHSU students who started using at least one university resource after the shelter-at-home will be significantly lower than the percentage of OHSU students who stopped using any university resource after the shelter-at-home mandate.

Hypothesis 3b: A significant association will exist between change in university or community food resource use and sociodemographic factors including age, gender, ethnicity, race, children in the home, marital status, household income, current length in program, tuition waiver, and international student status.

Aim 4: Determine the types of response behaviors and coping strategies used by students during the COVID-19 pandemic and the association of these response behaviors and coping strategies with food security status after enactment of the shelter-at-home mandate.

Hypothesis 4a: A significant association will exist between response behaviors used during the COVID-19 pandemic and food security status. Students who are food insecure will report higher rates of food-related stress, reduced motivation to cook healthy meals, reduced quality of foods purchased, and more difficulty accessing non-food related resources than their food secure peers.

Hypothesis 4a: A significant association will exist between coping strategies used during the COVID-19 pandemic and food security status. Students who are food insecure will report higher rates of spending $\leq$\$50 on groceries per week, leaving the home less often to grocery shop, that leaving the home less often impacts the amount of food needed in their home, purchasing less extra food, more interest in using a prospective campus food pantry, and preparing food less often.

Determining the relationships between food security status among the OHSU health professional and graduate student population and the shelter-at-home mandate to mitigate expansion of the COVID-19 pandemic will help inform future interventions to assist students with access to healthy food during broad-scale crises when university resources are reduced or unavailable.

CHAPTER 2: BACKGROUND

Food insecurity in the United States is a prevalent issue that impacts specific subgroups at higher rates than the general public with one such group being students enrolled in higher education especially those pursuing graduate degrees. Since food insecurity is associated with poorer mental, physical and academic outcomes, we must also better understand how a crisis event, such as the COVID-19 pandemic, impacts these students. Oregon Health & Science University (OHSU) is one of the many institutions that addresses food insecurity among students and where interventions are carried out to improve food security status.

Food Security Overview

Definition and Prevalence

In the United States, food insecurity is defined by the Life Sciences Research Office and the United States Department of Agriculture (USDA) as "the limited or uncertain availability of nutritionally adequate and safe foods or limited or uncertain ability to acquire acceptable foods in socially acceptable ways."[18,19] The USDA conducts an annual nationally-representative survey through the US Census Bureau to assess prevalence of food insecurity. Food security status is subdivided into four categories (Appendix A-1, Table 1): high food security, marginal food security, low food security, and very low food security.[1,20]

In September 2019, 10.5% of the US population surveyed reported experiencing food insecurity, of which 4.1% were classified as very low food secure.[1] Subgroups identified with higher prevalence of experiencing food insecurity were households with children, households with single mothers, adults living alone, Black and Hispanic households, and households with incomes below the 185% of the poverty threshold.[1] For students enrolled in higher education, additional characteristics have been associated with food insecurity including students

identifying as a race other than White, receiving financial aid and support, being financial independent, living off campus, and with lower household incomes.[7,21,22] Given that food insecurity is a prevalent problem in the United States and knowing that food insecurity often affects subgroups differently, it is important to identify certain subgroup characteristics and the unique interventions required to prevent or alleviate food insecurity.

Measuring Food Security

The USDA created a measurement tool known as the US Household Food Security Survey Module (US HFSSM) to measure food insecurity. The original survey, developed in the 1990s, included an 18-item questionnaire to assess food security status over the past 12 months.[23,24] Questions were also developed to determine severity of food insecurity ranging from least severe to most severe to help classify food security status.[16,19]

The 18-item questionnaire is used by the US Census Bureau to annually assess the prevalence of food insecurity through the Current Population Survey-Food Security Supplement (CPS-FSS), which has an internal consistency of α=0.73-0.91.[1,25] There are different variations of the US HFSSM including a 10-item survey, a 6-item survey, a 2-item screener, and a survey for individuals 12-years of age or younger.[19]

Variations of the US HFSSM were developed to diminish respondent burden by reducing the time need to complete the survey to assess food insecurity prevalence. The 6-item short form measures food security, food insecurity without hunger, and food insecurity with hunger and includes household and adult food security questions (Appendix A-2, Table 2). Based on validity markers, sensitivity and specificity of the 6-item short form is high but lower than the validity of the 18-item form.[24] In 1999, the US Census Bureau reported that the 6-item short form correctly identified 97.1% of food insecure households with an overall 92% sensitivity and

99.4% specificity. However, the short form was less sensitive and specific in identifying food insecure households with children.[26]

Concerns of validity and reliability of the US HFSSM measurement tools arise when using the survey in certain populations. The USDA modified the tools to assess food security status in adults and children under 12 years of age, but there is no tool specifically designed to assess food security status among adolescents and young adults – the age group of most university undergraduate and graduate students. When measuring food insecurity in the United States, 65% of studies used the 6-item or 10-item forms to assess food insecurity among college and university students. Additionally, the 6-item and 10-item forms produced higher weighted food insecurity prevalence rates (50% and 40%, respectively) than the 18-item questionnaire (13%) among the university student population.[2] The 10-item US HFSSM form produced inconsistent data pertaining to food insecurity because students were confused by questions that asked about "money," "balanced meals," and "weight loss." As a result, students were inappropriately categorized as food insecure.[27] Adding the US HFSSM 2-item screener questions before the 10-item or 6-item forms may provide more accurate responses to assess prevalence of food insecurity among college students.[16] The time reference of the questions within the US HFSSM may also impact food insecurity prevalence. When questions are asked in reference periods of less than 12 months, weighted food insecurity estimates were 47% compared to when questions are asked in reference periods of 12 months (31%).[2] In addition to confusion generated by the US HFSSM questions and time references, students pursuing higher education usually have different lifestyles and resources than adults who are not students, which, as a result, may produce less reliable and less valid results.

An additional modification to the US HFSSM was recently designed to assess food insecurity during the COVID-19 pandemic (Diane Stadler, PhD, RD, LD, email communication, May 18th, 2020). Two questions were adapted from the original 18-item questionnaire to screen survey responders (Appendix A-2, Table 2). Specifically, the COVID-specific questions eliminate a reference time period and ask respondents about their ability to purchase adequate quantities of food.

Food Security Status and Diet Quality

Food insecurity is negatively associated with diet quality among the general US adult population, which is likely related to reduced accessibility and affordability of healthy food options. The National Health and Nutrition Examination Survey (NHANES) includes the US HFSSM 18-item questionnaire, and 24-hour dietary recalls assessing food security status and diet quality. Between 1999-2008 NHANES data from 8,129 individuals categorized as low-income and with very low food insecurity reported 3% lower Healthy Eating Index scores, a measure of dietary quality, and increased consumption of high-fat dairy (8%), salty snacks (4%), processed red meat (5%), and sugar-sweetened beverages (12%).[28] Compared to food secure participants, those with low food insecurity also consumed 12% fewer servings of vegetables a day.[28] Similar findings were seen in the 2011-2012 NHANES data in which individuals who were food insecure had 1.5 higher odds (95% CI: 1.07,2.10) of consuming food from convenience stores and 9.4% higher mean energy intake than food secure individuals.[29] In addition, food insecure participants' diets were significantly lower in vitamin A, thiamin, riboflavin, niacin, pyridoxine, vitamin C, iron, magnesium, phosphorus, and zinc.[30] With limited ability to purchase healthy foods, poor diet quality may lead to nutrient deficiencies and poor health outcomes.

These results suggest food insecurity and diet quality are likely related, and that individuals who are food insecure may not have the ability to access or purchase healthier food options.[28-30]

Food Security Status and Coexisting Medical or Health Conditions

Similar to poor diet quality, food insecurity is associated with negative health outcomes in adults in the United States, which include higher weight status, chronic disease rates, and mortality rates. NHANES 1999-2006 data of 12,191 adults over 18 years of age established strong correlations between marginal food security status and body mass index (BMI) above 30 kg/m^2 and between high food insecurity status and BMI less than 18 kg/m^2.[31] BMI and rates of obesity are associated with food insecurity status[32,33] indicating that weight status, either being underweight, overweight or obese, are associated with limited access to adequate amounts of healthy food. Chronic diseases and risk factors for these conditions are often linked to inflammatory status and the immune system as measured by circulating C-reactive protein concentrations and white blood cell counts. In addition to weight status, individuals who were food insecure who participated in the 1999-2006 NHANES had 1.21 higher odds (95% CI: 1.04, 1.40) of having elevated blood C-reactive protein concentrations and a 2.45 higher odds (95% CI: 2.17, 2.77) of having white blood cell counts above 10,000 cells/uL.[31] In addition, food insecurity is associated with higher prevalence of risk factors including smoking (50.2%), heavy drinking (15.3%), hypertension (22.4%) and hyperlipidemia (21.7%).[33,34] Individuals who are food insecure also have higher odds of receiving a diagnosis of cancer (1.4, 95% CI: 1.02, 1.91), lung disease (1.8, 95% CI: 1.20, 2.63), cardiovascular disease (1.8, 95% CI: 1.12, 2.73), pre-diabetes in females (1.6, 95% CI: 1.22, 2.16), and Type II diabetes (2.4, 95% CI: 1.17, 4.94) than those who are food secure.[33,35,36] Those facing both food insecurity and Type II Diabetes experience more hypoglycemic episodes, elevated Hemoglobin A1c, and poorer medication

adherence.[34,37] Overall, individuals who are moderately and severely food insecure based on household income have about a 1.5 (95% CI: 1.23, 1.86) and 2.0 (95% CI: 1.55, 2.65) higher odds of mortality, respectively, than those who are food secure even after adjusting for factors such as age and gender.[38] Thus, food insecurity is highly associated with coexisting conditions that may affect weight, disease status, and mortality.

Food Security Status and Mental Health

Mental health is strongly associated with food security status among adults. Mental and physical health are often self-reported in cross-sectional surveys assessing food insecurity prevalence. In a sample of over 20,000 adults who responded to questions about mental health status (excellent, very good, good, fair, or poor) in the Canadian Community Health Survey, being food insecure was associated with 60% (95% CI: 1.45, 1.75) higher odds of poor mental health.[30] Similar findings in the United States were found among 1,488 households. Using the 12-item Short Form Health Survey questionnaire to assess overall health status, mean scores of respondents who were food insecure were 5.7 (45.7 ± 0.8 vs. 50.0 ± 0.3, $p<0.001$) and 6.9 (46.5 ± 0.8 vs. 53.4 ± 0.2, $p<0.001$) points lower for physical and mental health, respectively, than their food secure counterparts.[39] Mental health diagnoses and disorders, such as depression and anxiety, were not clarified in either of these samples. In a different study, among 287 low-income individuals with Type II diabetes, mental health was also evaluated using the 12-item Short Form Health Survey questionnaire and depressive symptoms were measured using the Patient Health Questionnaire (PHQ-8). Individuals who were food insecure had a lower mean mental health score of 4.3 ($p=0.003$), 2.8 (95% CI: 1.50, 5.31) higher odds of experiencing depressive symptoms and 2.3 (95% CI: 1.38, 3.91) higher odds of experiencing diabetes-related distress than those were food secure.[37] Poor mental health outcomes appear to be strongly

related to food insecurity and are some of many factors that could be a consequence of limited access to healthy food.

Food Security in Higher-Education Environments

Potential Causes

Based on the data derived from US HFSSM forms, food insecurity affects as high as 75% of students enrolled in higher education programs in the United States.[2] Risk factors that may lead to food insecurity among students enrolled in undergraduate and graduate degree programs include high education and living costs (Figure 1), among other expenses. In 2018, the National Center for Educational Statistics concluded that 57% of full-time and 19% of part-time undergraduate students were unemployed.[40] Data from the 2017-2018 National Center for Education Statistics estimated average tuition, fees, room and board costs for undergraduate and graduate students range from $20,000-$43,100 per year and $18,000-$46,000 per year, respectively, depending on location, state residency status, and type of institution.[41,42] More specifically, a higher percentage of students who are food insecure compared to student who were food secure report being financially independent and not receive financial assistance from their relatives.[7] There is also a higher percentage of students who are food insecure that report receiving monetary aid in the form of student loans to assist with educational and living expenses, being in debt, and spending less money on food compared to their food secure peers.[7,21] In a sample of 4,829 college students, having one or more part-time jobs and receiving financial aid were associated with a 48% (95% CI: 1.26, 1.75) and 65% (95% CI: 1.40, 1.95) higher odds of being food insecure, respectively.[43] With a large portion of undergraduate and graduate students participating in classes, experiential learning, and research on a full-time basis, the ability to afford and obtain adequate amounts of healthy food can be challenging.

With substantial debt and the responsibility to pay education and living expenses, cost of adequate amounts of healthy food often becomes a significant financial burden and less of a priority.

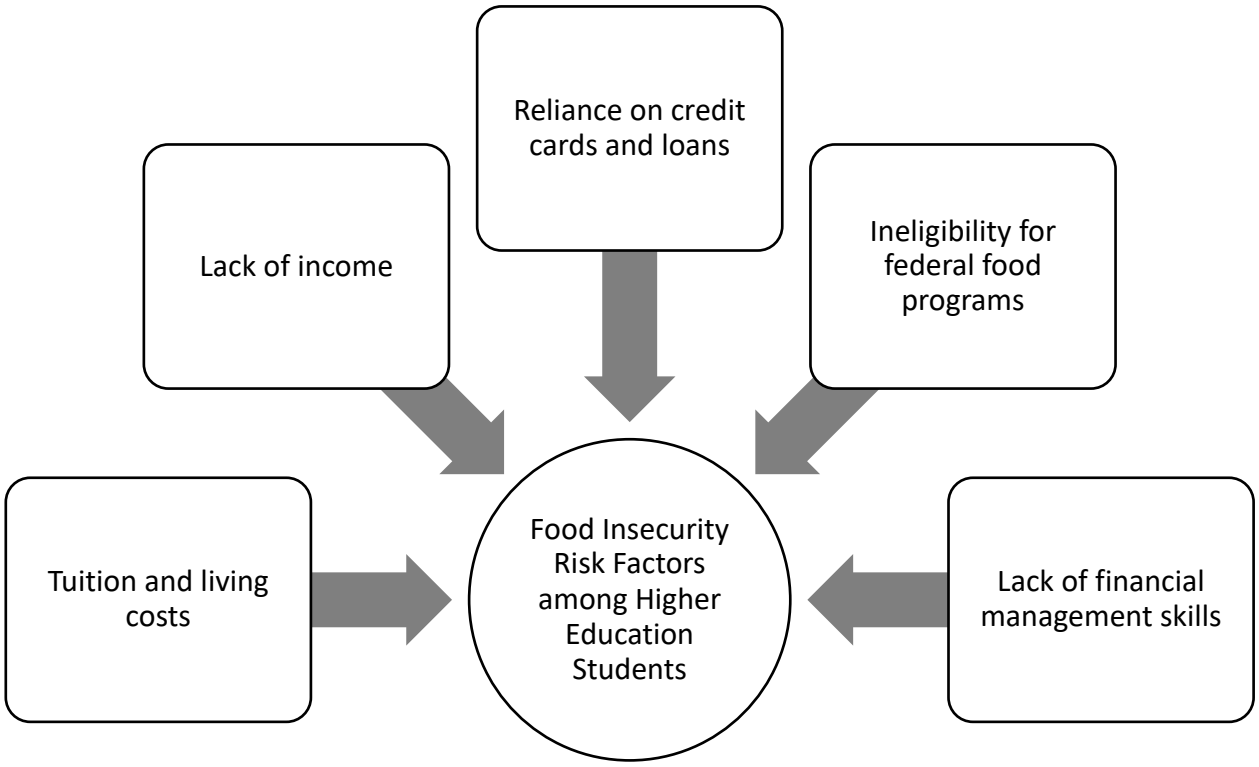

Figure 1. Risk Factors that Contribute to Food Insecurity Risk among Students Enrolled in Higher Education Programs.[7] Reprinted with permission from Gaines et. al. Copyright 2014, Clearance Center.

Food Security Status and Physical Health

The relationship between food insecurity and diet quality among students enrolled in institutions of higher education is similar to the general adult population. In a longitudinal study

collecting food insecurity data from 1,138 college freshmen, students who were food insecure had 33% (99% CI: 0.46, 0.99) lower odds of consuming breakfast and 45% (99% CI: 0.36, 0.86) lower odds of consuming an evening meal than students who were food secure.[3] Researchers did not identify reasons for skipping meals, such as academic schedule or lack of food resource availability, but the relationship between food insecurity and meal consumption pattern does indicate students may lack access to sufficient amounts of affordable and obtainable food. Foods within specific food groups are also less likely to be consumed if a student is food insecure, such as vegetables and fruits. In a cross-sectional study with a sample of 1,093 undergraduate (84.7%) and graduate students (14.1%) from a university in North Carolina, the US HFSSM 10-item was used to assess food security status. It was estimated that 46.2% of students were food insecure. Within this sample, 71.1% of students who were food secure reported consuming vegetables and vegetable juices compared to 56.1% of students who were food insecure.[44] In another cross-sectional sample, the US HFSSM 6-item short form identified 40% of 8,932 students attending California universities were food insecure, and food insecurity was associated with lower daily fruit and vegetable consumption ($p<0.001$).[6] These results suggest that students who are food insecure may not only lack access and resources to purchase and/or receive appropriate amounts of food but also have less ability to obtain appropriate food items that are considered healthy and contribute to dietary diversity.

Other lifestyle factors, in addition to diet, are associated with food insecurity among students. A longitudinal study assessing food security status among 855 first-year undergraduate students enrolled in one of eight different United States universities concluded that 28% of students were food insecure at baseline. Not only was prevalence of food insecurity higher by about 10% at the conclusion of the study, but average sleep quality scores were over

1 point higher (6.8 ± 2.8 vs. 5.4 ± 2.4, p<0.001), indicating worse quality sleep in students experiencing food insecurity based on a 21-point index. Additionally, 80.3% of students experiencing food insecurity reported experiencing poor sleep quality in the past month compared to 61.1% of students classified as food secure.[5] Similar evidence regarding sleep patterns was determined in the cross-sectional study assessing food security status among 8,932 students attending a California university. Food insecurity was strongly associated with fewer days of adequate sleep in the past week (p<0.001).[6] However, when looking at exact number of hours slept per day, the data were inconsistent. A separate survey of 200 undergraduate students used the 18-item US HFSSM to measure food security status. When comparing self-reported average hours slept per night, there was a significant difference between food secure students, individuals at risk for food insecurity, and students who were food insecure (p=0.0085). Compared to only students who were food insecure, food secure students only sleep an additional 0.46 hours (6.9 ± 1.16 vs. 6.44 ± 1.08).[22] Between the two studies, it is difficult to compare sleep schedules and quality due to the difference in data collected. However, quality of sleep may still be poor even when the number of hours slept drastically differ between students who were food secure and food insecure.

In addition to sleep quality, average physical activity among students who are food insecure is lower than their food secure peers. In a cross-sectional sample of 1,138 freshmen undergraduate students, greater than 30 minutes of moderate to high physical activity per day was completed by 3-5% fewer students who were food insecure than food secure.[3] Among students attending one of ten California institutions, food insecurity was strongly associated with fewer number of days that included moderate to vigorous activity in the past week (p=0.03).[6] Not only is food insecurity correlated with quality of sleep, but the amount of sleep

and the amount and intensity of physical activity are associated with food security status as well. It can be hypothesized that quality of sleep is lower with lack of adequate quality and quantity of food, and lower quality sleep results in reduced energy and ability to prioritize physical activity. Sleep may also be affected by the constant financial stress experienced by students when limited monetary resources are available. Thus, without proper food and sleep, stress and anxiety may be higher and energy for daily activities and exercise may be lower.

In addition to lifestyle factors, physical health outcomes are associated with food insecurity status. Of the 3,438 students who were food insecure who attended one of ten different California institutions, the average BMI (24.30 $\pm$ 5.55 kg/m^2) was significantly higher ($p<0.001$) than the average BMI (23.22 $\pm$ 4.32 kg/m^2) of students who were food secure.[6] Similarly among 1,093 undergraduate and graduate students, 38% who were categorized as food insecure were classified as overweight or obese.[44] In a cross-sectional sample of 855 first year graduate students, disordered eating scores measured by the Eating Attitudes Test-16 were significantly higher ($p<0.001$) among students who were food insecure (9.5 $\pm$ 9.1) compared to students who were food secure (7.0 $\pm$ 6.8).[5] However, in contrast, this study reported first-year students who were food insecure having similar average BMIs to those who were food secure (25.2 kg/m^2 $\pm$ 5.8 vs. 24.5 kg/m^2 $\pm$ 5.0, respectively, $p=0.112$), which is contrary to the previous data.[5] Self-reported health status also suggested students experiencing food insecurity had over a 2 times (95% CI: 1.09, 3.95) higher odds having fair or poor physical health compared to students not experiencing food insecurity[45] with studies estimating that 17%-26% of students who were food insecure rating their health as fair, poor, or suboptimal.[21,22,44] This percentage of students is significantly higher ($p<0.01$-0.001) than the

7%-9% of students who were food secure who rate their health similarly.[21,22,44] Measuring physical health status of students pursuing higher education is challenging because chronic diseases related to nutritional status develop over several years. However, students experiencing food insecurity may also experience poor diet quality, negative sleep patterns, reduced exercise, and lower self-reported health. Knowing these variables are risk factors for future nutrition-related illnesses, these associations with food insecurity may translate to earlier onset and more severe chronic diseases and higher rates of mortality than seen in the general adult population.

Food Security Status and Mental Health

Mental health conditions among students who are food insecure are prevalent issues and include symptoms of stress, anxiety, and depression. Students who are food insecure may be at higher risk for experiencing mental health issues because as food accessibility decreases, the worry and stress surrounding access to healthy food increases. In a longitudinal study of 855 first-year students from eight universities, students who were food insecure had a 4-point higher average (30.2 ± 5.7 vs. 26.7 ± 5.8, $p<0.0001$) perceived stress score compared to students who were food secure.[5] Freshmen who were food insecure and participated in a second longitudinal study had 69% (99% CI: 1.16, 2.46) higher odds of experiencing stress than their counterparts who were food secure.[3] It can be hypothesized that students experiencing food insecurity experience additional stressors related to accessing food that students who are food secure do not experience, which can translate to higher daily perceived stress. While higher-education environments may already be stressful, the added concern regarding having adequate resources to purchase food may elevate perceived stress among students.

Depression may be another mental health consequence impacted by food insecurity among students enrolled in higher-education institutions. The PHQ-9 has been used to measure depression symptoms in higher-education settings. In a sample of 237 undergraduate students, the percentage of students who reported having each of the nine symptoms of depression defined by the PHQ-9 was consistently higher for students experiencing food insecurity. Eighty percent of the students were categorized as food insecure and 54% of these students felt their symptoms of depression impacted their schooling,[22] which is similar to findings suggesting that students who were food insecure had a 98% (99% CI: 1.34, 2.91) higher odds of experiencing a depressed mood.[3] Similarly, the PHQ-9 and Adult Hope Scale identified in a longitudinal sample of over 2,000 students, depression and lower hope scores ($p<0.001$) were strongly associated with food security status.[17] With insufficient resources and lower ability to purchase the quality and quantity of food required, feeling emotions of hopelessness, sadness, and disinterest may be a few of many personal responses. Mental health, including stress, anxiety, and depression, appears to be strongly related to food security status, which may impact other areas of a student's life and their academic progress and success.

Academic Performance

Knowing that food insecurity influences physical and mental health in students enrolled in higher-education institutions, determining associations between academic success and access to food may be important to conclude current and long-term achievement. Grade Point Averages (GPA), on a 4.0 scale, is one measure of student achievement in school. When measuring food security status in 855 first-year undergraduate students using the 10-item US HFSSM, a significantly higher proportion of students who were food insecure (8.2%) reported a current cumulative GPA of 2.50-2.59 compared to 4.4% of students who were food secure,[5]

which supports the suggestion that lower GPAs are strongly associated with food insecurity in higher-education settings.[17,46] Students experiencing food insecurity from a sample of 692 undergraduate students not only had a 0.18 point lower mean GPA (3.51 $\pm$ 0.02 vs. 3.33 $\pm$ 0.03, $p<0.0001$) than students who were food secure, but also had lower mean academic success scores (12.39 $\pm$ 0.13 vs. 13.28 $\pm$ 0.09, $p<0.0001$, respectively).[21] Students may find that with insufficient amounts and types of food, they are less able to focus on their academic goals. In addition, the association between food insecurity and worse physical and mental health outcomes may indicate that students are unable to concentrate on academics when suffering these related consequences of food insecurity.

University and College Campus Resources to Support Students who are Food Insecure

University campus resources have been developed to address the high prevalence of food insecurity experienced by university students. Direct food distribution programs offer students the ability to access food through on-campus food pantries and mobile or pop-up food distribution sites. Feeding America, a national hunger-relief organization, surveyed 150 food banks and found that 110 were involved in direct food distribution to college campuses. Just over 30% of food banks also offer Supplemental Nutrition Assistance Program (SNAP) application assistance programs.[47] According to the United States Government Accountability Office, over 2.2 million students self-reported receiving SNAP benefits in 2018 with 31% of these students being low-income or having an income of 130% at or below the federal poverty level.[48] The Feeding America report indicated that community partners with university and college campuses and direct campus support can provide students with food, nutrition education and financial assistance to lessen food insecurity. Interventions to target and assist students on campus include access to food vouchers, providing application advisement aid for

government assistance programs, and developing and distributing food through centers such as food pantries[9].

With a high food insecurity prevalence among students attending higher-education institutions, additional resources on campus are still needed. In a sample of over 1,000 sophomore undergraduate students through graduate students, 90% of students reported that they could use more campus support to access food.[44] Food pantries are developed to provide students with access to a variety of food. Of 58 students using an on-campus food pantry, over 80% liked using the resource, but 29.3% did not know how to prepare the foods offered, which might result in food not being consumed.[49] Similarly, of 899 undergraduate and graduate students, 15.6% utilized the food pantry and 36.4% reported using this resource as a primary food source. However, food insecurity was strongly associated with barriers to accessing the food pantry, such as hours of operation, not understanding eligibility or how to use the resource.[8] Campuses are equipped to offer feasible and accessible food resources to students experiencing food insecurity, but students may face communication and psychological barriers such as the ability to access campus resources, avoiding perceived social stigma of using these resources, and the ability to prepare unfamiliar foods. In addition, these resources typically require access to campus, and therefore, may not be feasible when personal contact is limited as experienced during the COVID-19 shelter-at-home mandate.

Addressing the stigma around accessing these supplemental student resources is critical to make them readily available, effective, and convenient for this population. Stigma is defined as "a strong feeling of disproval that most people in society have, especially when unfair."[50] Among 899 students attending the University of Florida, 36.8% of students reported social stigma and embarrassment as a major barrier to using the on-campus food pantry.[8]

Understanding stigma and perception of food insecurity indicates a need to market and provide resources that are not strictly targeted at those who are food insecure. These researchers suggested designing a food pantry or resource center that included programs to target all students such as providing cooking classes, screening for SNAP eligibility, and teaching food resource management skills.[8] These programs could be used by all students without segregating or identifying students who are food insecure, which may help reduce this stigma.

Coping Strategies of Individuals Experiencing Food Insecurity

Food insecurity requires those experiencing it to use coping strategies defined as actions or thought processes used by an individual to tolerate or deal with a stressful situation.[51] Different types of coping strategies are used by the general population, which include individual and social strategies. In a convenience sample of 141 participants using low-income community services, focus groups identified that over 80% were assisted by federal or private programs to improve food security status. This includes government nutrition assistance programs and food banks.[52] Low-income residents in Oregon identified using resources including soup kitchens, community food pantries, and government nutrition assistance programs.[53] Individuals in both studies also identified personal coping strategies such as purchasing low-cost foods, stretching food to make more meals, budgeting, staggering when bills are paid, eating less food, and relying on faith. Social coping strategies focused on the reliance of friends and family for meals, money, and emotional support, but the support was described as transactional or "the need to return the favor."[52,53] Individuals experiencing food insecurity are forced to find resources to manage access to adequate amounts and types of food. They may use multiple methods to maximize coping, and thus, combine individual and social strategies.

Higher-education student populations may use some of the same coping strategies as the general population to address personal food insecurity, but the unique lifestyle of full-time or part-time students requires supplementary strategies. Qualitative interviews among 23 students who were food insecure at a midwestern research university showed similar coping strategies comprised of skipping meals, using friends' meal cards, and ignoring hunger cues. In addition to these coping strategies, students felt that their experience with food insecurity and managing the effects of food insecurity led to feelings of hopelessness and to academic difficulties.[54] Additionally, a 29-item coping strategy scale (CSS) identifies tactics an individual may use, including approaches related to saving money, asking for support, food access, and selling items. When assessing the CSS in a cross-sectional sample of over 1,000 undergraduate sophomore and graduate students, CSS scores were positively associated with US HFSSM scores ($r=0.42$, $p<0.001$). This association suggests students with higher food insecurity used a higher number of coping strategies more frequently.[44] Additionally, a convenience sample of students using an on-campus food pantry identified different coping strategies for domestic and international students. The highest rated coping strategies among international students included seeking employment (85.2%), purchasing food using a credit card (70.4%), delaying or not purchasing university supplies (74.1%), or applying for a loan or bursary (70.4%). For domestic students, applying for a loan or bursary (90.3%), purchasing food using a credit card (83.9%), and seeking employment (80.6%) were the predominant choices.[55] Students are faced with different challenges and choices to cope with food insecurity than the general population due to the cost of education. They apply for student loans to ensure tuition is paid, find employment opportunities while taking classes, and withhold purchasing school supplies. These

coping strategies provide temporary relief but cannot completely mitigate the cumulative financial debt and the emotional stressors in order to help facilitate academic success.

Food Security in Crisis Events

Food insecurity is a prevalent problem in the United States, which becomes more apparent and urgent during specific crisis events that lead to reduced accessibility to food resources. Natural disasters in the United States produce harmful physical effects on individuals and communities and reduce available resources in the aftermath. Hurricane Katrina devastated communities in the southern regions of the United States in 2005. Household food security status of the communities affected by Hurricane Katrina was measured in 2009 among 737 households using a one-item US HFSSM screener question. Not only did 22.5% of households report difficulty purchasing food, but those classified as food insecure had higher prevalence of disability (33.1% vs. 16.6%, $p<0.001$), physical health distress (68.1% vs. 47.8%, $p<0.001$), and post-traumatic stress disorder (18.1% vs. 6.0%, $p<0.001$) than food secure households.[56] Similarly, when Hurricane Harvey in 2017 impacted many Texas households, a 2-item US HFSSM screener question assessed food insecurity among 1,002 affected households. The screener classified 42.3% of these households as food insecure after the natural disaster, with food insecure homes having a 2.4 (95% CI: 1.73, 3.41) higher odds of adults in the household being unemployed as a result of the hurricane.[57] These natural disasters may be isolated events and communities may be affected differently depending on resources and policies present preceding the event. However, crisis events like these show that food insecurity may increase and dramatically change households' normal access to food. Additionally, the likely consequence of natural disasters is the increase of unemployment which

possibly limits the ability to access food resulting in the increased risk of food insecurity in the immediate aftermath and years beyond.

Economic recessions are another crisis event associated with increased rates of food insecurity across several populations. The Economic Recession of 2008 caused drastic increases in unemployment throughout the United States. Of 14,417 US households in 2008 who participated in the Survey of Income and Program Participation, 9.7% were food insecure and 17.8% included adults in the household who were unemployed. For each additional week of unemployment, the odds of being food insecure increased by 1% ($p<0.01$).[58] The Survey of Income and Program Participation administered after the 2008 Economic Recession determined that being unemployed one or more times raised the odds of food insecurity by 20% (95% CI: 1.12, 1.28).[59] It can be hypothesized from these Survey of Income and Program Participation results that unemployment and consistent income drastically affects the ability to access food. Thus, the global crisis of the Economic Recession in 2008 suggests that with increases in unemployment rates, food insecurity may be a common consequence resulting from a crisis event.

Social isolation is an additional component of crisis events closely linked to food security status. Not only may social isolation be a result of crisis events, but social isolation is linked to food insecurity among those experiencing the crisis. The Surveys of Income and Program Participation administered after the 2008 Economic Recession determined that low-income households had a mean social support score of 4.4 ± 2.3 compared to their food secure counterparts with a mean score of 5.4 ± 2.5 ($p<0.001$). The social score was calculated based on assistance from family, friends, social agencies, and churches.[59] Among food insecure households affected by Hurricane Harvey, members of these households had a 63% (95% CI:

0.25, 0.55) lower odds of receiving social support from another individual.[57] Social isolation may be a prevalent problem since households experiencing food insecurity during a crisis event face challenges with accessing limited resources, which include social resources. Additionally, the results of the 2009-2010 Canadian Community Health Survey suggested that food insecure households had higher prevalence of "feeling weak community belonging" compared to food secure homes (22.8% vs. 8.8%) even when not experiencing a crisis event. The researchers who administered the survey hypothesized that food insecure households lack access to social support systems and services that assist with food security and mental health.[60] It may be hard to determine if social isolation is a response to food insecurity or if it is a determinant of food security status, but regardless of the direction of the association, the relationship remains consistent. Food insecurity is associated with the perception of community belonging and social support systems, which appears to be an important resource to those who are food insecure.

Oregon Health & Science University Student Food Security

Oregon Health & Science University (OHSU) is a public institution that provides education and training for future health care professionals. OHSU registered 3,017 students in the Fall of 2019 including enrollment for graduate, undergraduate, and non-degree programs. This enrollment number accounted for students in the Schools of Medicine, Dentistry, Nursing, and Public Health but excluded students enrolled in joint programs such as the College of Pharmacy.[61] In 2016, an initial survey was deployed to OHSU students and out of 547 responses, 21% answered affirmatively to at least one of the US HFSSM 6-item short form questions [4] suggesting that OHSU students may experience food insecurity at high rates. A comprehensive survey in 2018 was deployed by the OHSU Food Insecurity Task Force to OHSU students. Of the 1,133 students who completed the survey, 28.5% reported experiencing food

insecurity and 36% experienced physical effects from lack of food at least every few months. Twenty-three percent of students felt that lack of food influenced their academic performance, with food insecurity contributing to 11.7 (95% CI: 8.33, 16.55) higher odds of affecting academic performance.[4] OHSU students are similar to students of other US institutions of higher-education since the estimated range of food insecurity among this population is 10-75% with a weighted estimate of 41%.[2] Not only is food insecurity prevalence higher than the national average, but physical health and academic success are greatly impacted by the lack of food these students who were food insecure experience.

This 2018 survey administered to students at OHSU also identified possible solutions the university could take to combat food insecurity. Providing student food discounts, developing a web-based food recovery app and resource list, and offering a food truck and/or food pantry were the top choices selected by students.[4] Based on these results, the OHSU Food Insecurity Task Force worked with the university's Food and Nutrition Services to establish on-campus retail food discounts, a Food Resource Guide, and a meal-in-a-bag program for students to collect food at the Student Health and Wellness Center. A food recovery app is being developed but has been delayed since March 2020. This delay was due to the current COVID-19 global pandemic when the governor of the State of Oregon issued an executive order that required all non-essential members of the OHSU work force, including students, to stay at home and follow the guidelines issued by the CDC to practice "physical distancing".[13] OHSU entered "modified operations," and students were restricted from campus following recommendations from the CDC[12], which limited their access to resources to supplement food. However, a campus food resource center has been in operation since December 2020 to help provide food to students during the pandemic. Additionally, the pandemic led to millions of job losses including student

worker positions with United States employment down by 19.6 million as of May 2020.[62] Thus, reduced income and lack of access to campus resources created barriers to accessing supplemental food for OHSU students.

As mentioned before, students enrolled in higher-education institutions are at a high risk for experiencing food insecurity, which can negatively impact physical health, mental health, and academic performance. With many campus resources aimed at improving food security status, the current COVID-19 pandemic creates challenges for students to access low or no-cost healthy food. Limited income from unemployment, lack of campus resources, and social isolation resulting from the shelter-at-home mandate may contribute to higher prevalence of food insecurity in the OHSU student population. To better describe how the COVID-19 pandemic contributes to food security status of students enrolled at OHSU, this study accomplished the following aims: 1) describe prevalence of food insecurity among the OHSU student population before and during the 2020 COVID-19 pandemic, 2) compare prevalence of food insecurity among OHSU students who responded to the US HFSSM 6-item short form administered in the Spring of 2018 and the national prevalence of food insecurity in 2019 to the OHSU students who responded to the food insecurity screener in 2020, 3) determine the use of university and community food resources that assist with access to food among the OHSU student population, and 4) identify response behaviors and/or coping strategies used by students experiencing food insecurity during the COVID-19 pandemic.

CHAPTER 3: METHODS

To achieve the study goals, changes in food security status and university and community food resource use were assessed among a sample of health professional and graduate students enrolled at Oregon Health & Science University (OHSU). A cross-sectional survey was disseminated to assess food security status 12-months before and 2-3 months after the shelter-at-home mandate using the validated USDA Household Food Security Survey Module 6-Item Short Form (US HFSSM). Questions pertaining to response behaviors and coping strategies during the pandemic and a free response question were included at the end of the survey to understand how OHSU could better support students who were food insecure.

General Design

The design of this research was informed by observational studies that began in 2018 to assess the prevalence of food insecurity among students enrolled at OHSU. The current cross-sectional study of students enrolled in undergraduate and graduate academic programs at OHSU was conducted between June of 2020 and November of 2020. Students were invited to complete a survey that contained 45 questions to assess food security status and use of OHSU and community supplemental food resources before and during the COVID-19 pandemic. Response behaviors and coping strategies used by and experienced by were also assessed.

Study Population

Full and part-time students registered and enrolled in classes at OHSU during the Spring, Summer, and Fall terms in 2020 were invited to participate in this study (n=2,800). Students were enrolled in the College of Pharmacy, and the Schools of Medicine, Public Health, Dentistry, or Nursing. Students matriculating in the Summer or Fall terms of 2020 and students who did not

respond to any one or combination of the USDA Food Security questions were excluded from analysis.

Recruitment Methods

A timeline illustrating student recruitment and survey dissemination is presented in Figure 2. Recruitment of students to participate in this study began at the end of the Spring term and extended into the Fall term of 2020. Initially, students were invited to complete the survey through emails sent by OHSU Strategic Communications. This email included a link to the survey along with an information sheet describing the study (Appendix B). Deans and Program Directors of each OHSU School/College/Program sent email reminders to students to amplify the importance of assessing food security status of and to encourage students' participation (Appendix C).

Student bulletins, which included program-specific social media pages, graduate program newsletters, and Student Health Advisory Committee emails, dispersed the same recruitment message and links to the survey. The Provost Office also sent an email message to students with the link to the initial OHSU Strategic Communications message and survey link. Students enrolled in the Summer and Fall 2020 term were sent an additional recruitment message and OHSU intranet link to the survey posted on the OHSU course management system, Sakai.

Consent and Confidentiality

Students were provided a study information sheet embedded as a link to the online survey to read before completing the survey (Appendix B). This information sheet described the study protocol and notified students that the findings from the study may result in one or more publications, but their responses would only be reported in aggregate form. The information sheet also informed participants that completion of the survey was voluntary, and submission of

their completed survey acted as implied consent to participate in the study. Students were informed that completion and submission of the survey was done anonymously and that no personal identifiers would be collected and, thus, attributable to them.

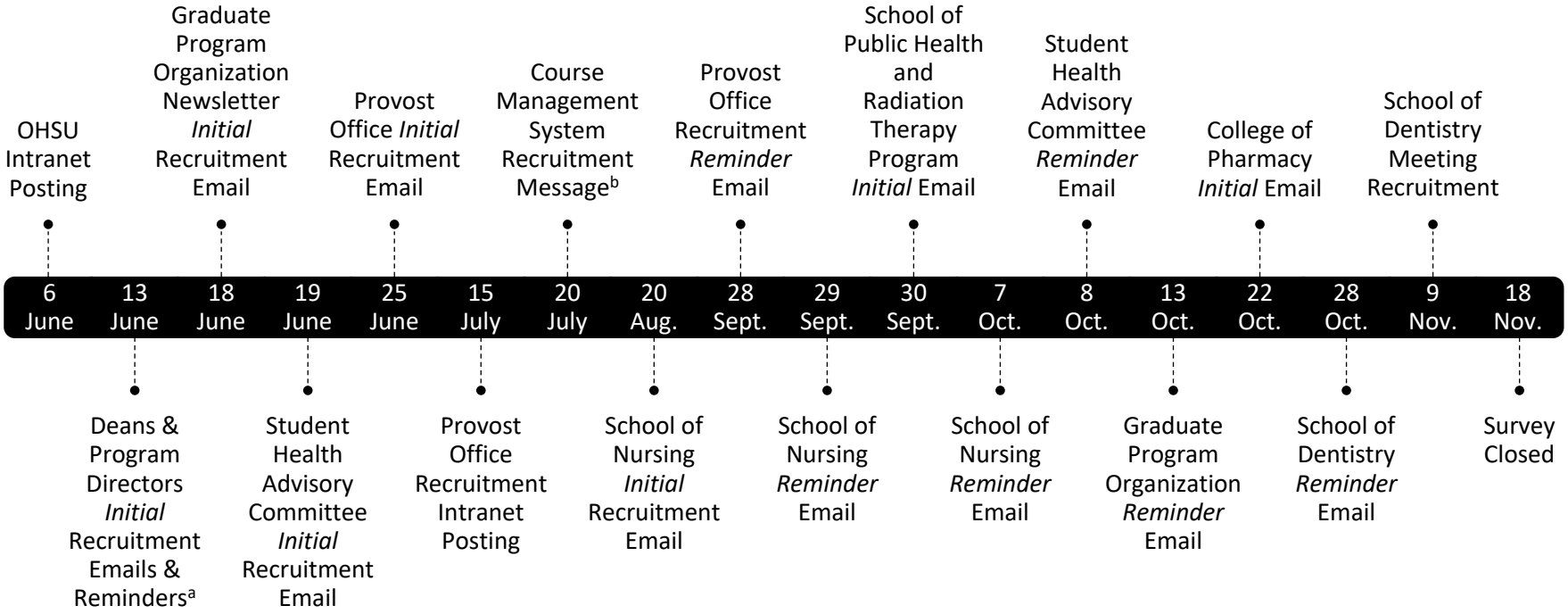

Figure 2. Student Recruitment and Survey Dissemination Timeline.

Initial and reminder emails are italicized to demonstrate the difference between when an email was first sent to students and subsequent emails.

[a] Initial recruitment emails were sent from the School of Dentistry and School of Medicine.

[b] The course management system message was displayed on the login page before students accessed course information. The message was removed November 2nd, 2020.

Institutional Review Board and Provosts Administration Approval

Study approval was obtained from the OHSU Institutional Review Board (IRB #17281) as a modification to the original proposal to conduct the 2018 food insecurity survey. Modification of the IRB included restructuring the initial survey to update the survey questions. Questions pertaining to ways OHSU could mitigate food insecurity were replaced with questions pertaining to the pandemic, use of university and community food resources, and restructured US HFSSM 6-item short form questions. Modifications also included updated recruitment messages, methods and edits to the original informational sheet. The OHSU's Provost Administration was informed of and approved the survey dissemination protocol as required in an effort to reduce survey fatigue among students.

Survey Structure

The survey was comprised of four sections and included a total of 45 questions (Appendix D) that asked about sociodemographic characteristics, food security status, food resource use, and response behaviors and coping strategies used during COVID-19. Food security questions were adapted from the original 2018 food security survey and modified to address the current COVID-19 pandemic and use of university and community food resources. The survey was piloted by three OHSU graduate students for understanding and interpretation so that survey questions could be modified as appropriate before survey deployment. Survey questions included a combination of Likert scale, multiple choice, yes/no, and free text responses.

Sociodemographic Characteristics

The first section of the survey contained 13 questions to assess sociodemographic characteristics of the OHSU student sample. Questions asked about age, gender, race, ethnicity,

income, and number of individuals and number of children in the household. Additional questions asked about OHSU program enrollment, current and remaining years in the respective program of study, recipient of tuition waivers, and international student status.

Food Security Status

The second section of the survey addressed food security status and contained 13 questions. Food security status was characterized using the US HFSSM 6-item short form. The US HFSSM 6-item short form contained six questions addressing experiences with food insecurity over a specified time period (Appendix A-2, Table 2). Affirmative answers were classified as "positive" answers indicating possible food insecurity. If a response to any of the six questions was affirmative, one point was added to the food insecurity total score with a maximum score of six. The sum of the affirmative answers determined food security status using the USDA's recommendations for dichotomizing food security status into food secure or food insecure categories (Appendix A-3, Table 3).[63]

Food security status was measured twice for each participant using the US HFSSM 6-item short form. The first set of US HFSSM questions were asked in reference to the 12 months prior to the shelter-at-home mandate in response to the state of Oregon Governors' Executive Order and CDC's recommendations for physical distancing.[12,13] The US HFSSM questions were asked a second time but in reference to the 2-3 months after the shelter-at-home mandate was issued. Two food security scores were calculated for each respondent to measure food security status before and after the shelter-at-home mandate in response to the COVID-19 pandemic.

University and Community Resources

The third section of the survey contained eight questions and asked participants about their use of university and community resources to access supplemental food 12 months before

and 2-3 months after the modified operations and shelter-at-home mandate was issued in response to the COVID-19 pandemic. This section included additional questions to better understand use of university food outlets and resource needs. Specifically, these questions asked about use of university vending machines, cost of university vending machine foods, satiety of foods from university vending machines, acceptance and planned use of a future on-campus food pantry, preferred food pantry items, and preferred food pantry hours of operation.

COVID-19 Response Behaviors and Coping Strategies

The fourth section of the survey contained nine questions that addressed the COVID-19 pandemic and how it impacted ability to access supplemental food and additional supportive resources. Questions were worded in reference to the 2-3 months after the modified operations status at OSHU was implemented and the shelter-at home mandate was issued. Response behaviors were defined as a specific action taken or feeling attributed to the COVID-19 pandemic and included food-related stress, motivation to cook healthy meals, quality of foods purchased and access of non-food related resources. Coping strategies were defined as specific actions taken or tactics used to adjust to changes in an individual's life specifically relating to the COVID-19 pandemic and included weekly grocery shopping cost, leaving the home to grocery shop, whether leaving the home less often impacted the amount of food needed in the home, purchasing of food, preparation of food, and use of a future food pantry on campus.

Survey Dissemination and Data Storage

The survey was deployed as an online, self-administered questionnaire and was estimated to take 10 to 15 minutes to complete. The survey was hosted by a secure survey platform (Qualtrics, Provo, Utah) and the link to the survey was distributed through OHSU

Strategic Communications via the OHSU secure e-mail system and through direct emails to students.

Data collected from this survey were stored on a secure survey platform (Qualtrics, Provo, Utah) accessible by study personnel only. Data will be stored for up to seven years and archived in a repository managed by the principal investigator.

Sample Size Calculation

A power analysis was conducted using food insecurity prevalence data of OHSU students from the 2018 survey that was published in 2020.[4] The 2018 data stated about 25% of students were food insecure. Based on another published research article in the summer of 2020, 34.5% of students attending a Texas university were food insecure a few months after the start of the COVID-19 pandemic in March of 2020. The 10% difference in prevalence of food insecurity between the 2018 OHSU survey data and the Texas university published data were used as the effect size to determine the sample size for the 2020 survey.[64] Use of the 10% effect size resulted in an estimated sample size of 250 student responses needed to measure a 10% difference in prevalence in food insecurity in 2020 after the start of the COVID-19 pandemic compared to 2018.

Data Analysis

Data were analyzed using Stata/IC 16.1 software (StataCorp. 2019. Stata Statistical Software: Release 16. College Station TX: StataCorp LLC.) and figures were created using Microsoft Excel 16.45 (Microsoft Corporation, 2021). Differences were considered significant when the alpha level was 0.05 (Appendix E). Descriptive statistics, primarily frequencies (categorical variables) but also measured standard deviations (continuous variables), were used

to characterize the study sample and were compared to the 2019 OHSU enrollment data and the 2018 survey data. Two-sided, two-sample T-tests and tests of proportions were used to assess differences in means and frequencies, respectively.

McNemar's tests and chi-square or Fisher's exact tests were used to determine associations between sociodemographic data and food security status data. Two-sided, two-sample tests of proportions were completed to determine the strength of association between demographic variables and food security prevalence.

Two food security status summary scores were calculated for each participant to determine prevalence of food insecurity before and after the shelter-at-home mandate. Food security classification was based on the number of affirmative answers to the US HFSSM 6-item short form questions. The food security classification groups were: 0-1 indicating high/marginal food security status, 2-4 indicating low food security status, and 5-6 indicating very low food security status. To convert the food security scores to be dichotomous variables, food security and food security status were collapsed into the following two categories: 0-1 (food secure) and $\geq$ 2 (food insecure) following USDA classification.[65]

Specific Aim 1: Change in Food Security Status

McNemar's test was used to determine significant associations between change in food security status before and after the shelter-at-home mandate. Fisher's exact tests were used to determine associations between change in food security status and sociodemographic variables that were statistically significant in the 2018 survey and within the literature including age, gender, ethnicity, race, children in the home, marital status, household income, current length in program, tuition waiver, and international student status. Sociodemographic factors were dichotomized except for gender and race, which had more than two possible classifications. Age

was separated into those <30 years or ≥30 years of age consistent with the 2018 survey data findings that those who were food secure had a mean age of 29.9 ± 6.6.[4] Duration (years) in current program was separated into <3 years and ≥3 years based on current literature findings that students in their third year of undergraduate education are more likely to be food insecure.[21,46] Marital status was combined into Single/Separated/Divorced/Widowed or Married/Partnered. For income, two cutoffs were used. First, students were separated into those who reported an annual pretax income ≤$25,000. This was consistent with the 2020 Census Bureau poverty thresholds for households with no children comprised of three or fewer people since the average number of individuals in the household was 2.5 ± 0.9.[66] Students were then separated into those reporting an annual pretax income of ≤$50,000 based on the 2018 survey findings that food insecure individuals were more likely to have an income ≤$50,000.[4] Two-sided, two-sample tests of proportions were used to compare those who became food insecure after the start of the pandemic to specific sociodemographic variables.

Specific Aim 2: Prevalence of Food Insecurity

The prevalence of those classified as food insecure (total food insecurity score ≥ 2) before and/or after the shelter-at-home mandate was compared to food insecurity prevalence derived from the 2018 survey and 2019 national food insecurity prevalence results. Two-sided, two-sample tests of proportions were used to compare the proportion of food insecure participants before and after the shelter-at-home mandate to the 2018 survey food insecurity prevalence. A two-sided, one-sample test of proportion was used to compare the proportion of food insecure participants before and after the shelter-at-home mandate to the 2019 national food insecurity prevalence.

Specific Aim 3: University and Community Food Resource Use

The use of specific university and community resources before and after the shelter-at-home mandate was described as frequencies for each resource. Use of university and community resources were categorized as use of 0 resources or ≥ 1 resource. McNemar's tests were used to determine significant associations between the change in use of community and university resources before or after the shelter-at-home mandate. Fisher's exact tests were used to determine associations between change in university and community resource use and sociodemographic variables that were statistically significant in the 2018 survey and within the literature including age, gender, ethnicity, race, children in the home, marital status, household income, current length in program, tuition waiver, and international student status. These sociodemographic variables were dichotomized in a similar way to the sociodemographic factors used to compare to food security status. Two-sided, two-sample tests of proportions were used to compare the same sociodemographic variables with those who moved from using ≥ 1 resource to none.

Specific Aim 4: COVID-19 Response Behaviors and Coping Strategies

Response behaviors and coping strategies for COVID-19 pandemic variables were collapsed into bivariate groupings. Response behaviors included food-related stress, motivation to cook healthy meals, purchasing quality foods, and accessing non-food related resources. Coping strategies included weekly grocery shopping cost, leaving the home to grocery shop, purchasing extra food, interest in using a future campus food pantry, and food preparation. Chi-square tests were used to determine significant associations between food security status after the shelter-at-home mandate and each response behavior or coping strategy. Two-sided, two-sample tests of proportions were used to compare the proportion of response behaviors and

coping strategies used by those who were food insecure to those who were not food insecure 2-3 months after the shelter-at-home mandate.

Qualitative Analysis

All free response text questions were read and coded by two researchers. These researchers collaborated to agree upon the theme categories that emerged from the codes, and free responses were reported by their respective descriptive code. Open coding was used to discover categories based on the free response data collected. Codes and their respective sub-categories and themes were generated inductively allowing for changes to codes if new patterns appeared.[67,68] All student responses were included regardless of exclusion criteria used for the quantitative analysis.

CHAPTER 4: RESULTS

Of the 175 students who completed the survey and were included in the analysis, the same proportion of students were food insecure before and during the pandemic. Prevalence of food insecurity was also not significantly different from the 2018 estimates of OSHU student food insecurity prevalence. Use of any OHSU food resource, but not community resource, was significantly lower after the shelter-at-home mandate than before. Lastly, a significantly higher proportion of students who were food insecure than food secure reported response behaviors and coping strategies used during the COVID-19 pandemic.

Study Participants

A total of 273 students responded to the survey by the close date, of whom a total of 175 met the inclusion criteria (Figure 3). The mean age of participants was 29.5 ± 6.18 years and 81% reported their gender as female (Table 5). The most commonly reported programs of study were Physician Assistant (28%), Graduate Medicine (21.1%), and Medical School (17.7%) programs with most participants in their first 1-2 years of their respective program (52.9%). The racial distribution of students was White (74.1%), Asian or Pacific Islander/Native Hawaiian (11.5%), and multi-racial (9.8%); 93.7% reported being non-Hispanic/Latino. Other races described were Middle Eastern (1.1%) and Indian (0.6%). Most participants were single (56%) with a mean of 2.5 ± 0.90 individuals per household. The most common reported annual pre-tax household incomes were between $25,001-$50,000 (26.9%) followed by <$12,000 (23.4%). Students reported full or part-time employment (29.9% ± 37.7), government loans (25.8% ± 36.9), and stipends from OHSU (17.5% ± 36)) as the most common sources of overall household income. Compared to 2018 survey data and 2019 registration data, a significantly higher

proportion of respondents identified as female in the 2020 survey (p=0.0016 and p=0.0001, respectively). Compared to 2018, more students were enrolled in the Physician Assistant (p<0.001) and College of Pharmacy (p=0.0034) programs while fewer students were enrolled in the School of Dentistry (p=0.0287) and School of Nursing (p<0.001). There was also a higher mean number of individuals per household and a higher proportion of households with no children (p<0.001).

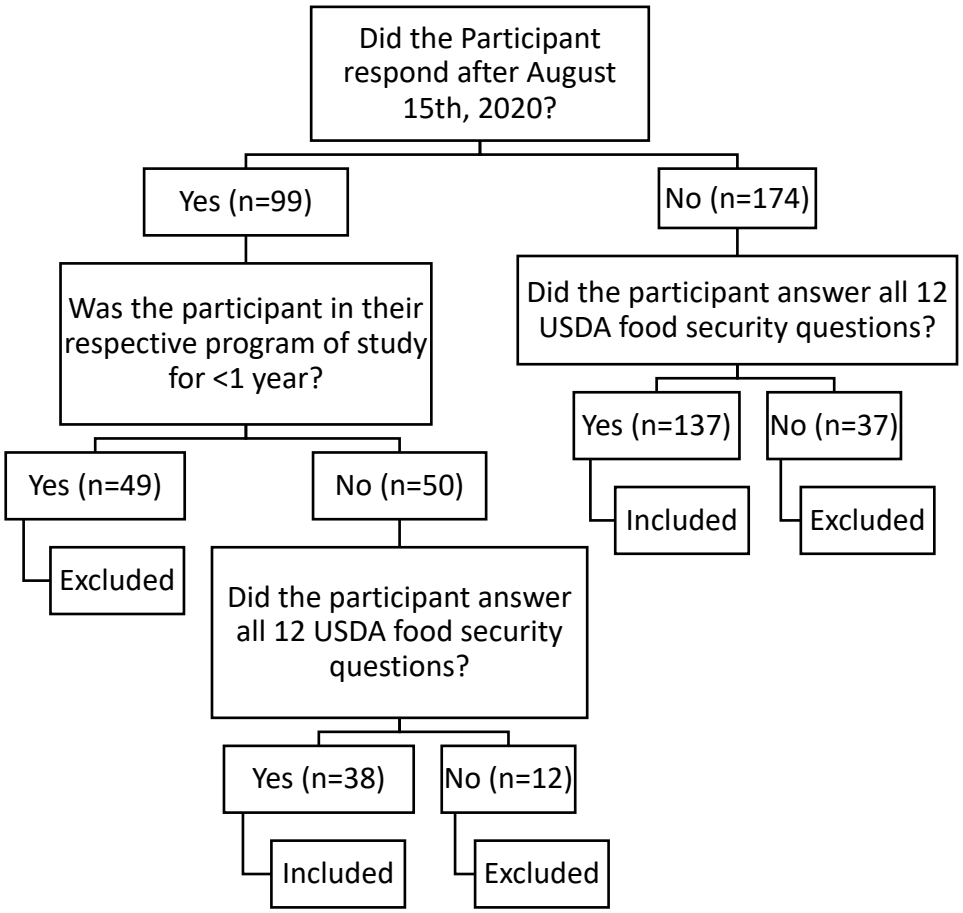

Figure 3. Participant Inclusion Decision Tree.

Figure 3 shows participants included in the study analysis based on A) when the participant responded to the survey, B) if the respondent was in their respective program for <1 year, and C) if the participant answered all 12 USDA food security questions. Those participants included or excluded after answering each question are shown (n) based on the total number (n=273) of

student respondents. A total of 175 students were included in the analysis based on the above criteria.

Table 5: Study Participant Characteristics from 2020 and 2018 Surveys and 2019 OHSU Enrollment Data

	OHSU 2020 (n=175)[a]	OHSU 2018[4] (n=1133)[a]	OHSU 2019 Enrollment[61] (n=3017)[a]
Age in years, mean ± SD	29.5 ± 6.2	29.6 ± 6.3	N/A
Gender n (%)			
Female	141 (81.0)*	785 (69.3)	2012 (66.7)
Male	31 (17.8)*	32 9(29.0)	998 (33.1)
Non-Binary	1 (0.6)	10 (0.9)	N/A
Transgender	1 (0.6)	5 (0.4)	N/A
Prefer not to answer/Undeclared	N/A	4 (0.4)	7 (0.2)
Program of Study, n (%)		n=1049	
Physician Assistant	49 (28.0)**	77 (7.3)	
Graduate Programs (Certificates, M.S. or Ph.D.)	37 (21.1)		759 (25.2)[c]
Medical School	31 (17.7)	502 (47.9)[b]	630 (20.9)
School of Nursing	16 (9.1)**	271 (25.8)	1036 (34.3)
College of Pharmacy	11 (6.3)**	24 (2.3)	N/A[d]
School of Public Health	10 (5.7)	85 (8.1)	231 (7.7)
School of Dentistry	7 (4.0)**	90 (8.9)	323 (10.7)
Undergraduate Health Profession Programs	7 (4.0)		38 (1.3)
Human Nutrition	7 (4.0)		
Years in Current Program, n (%)			N/A
<1 year	37 (21.3)**	381 (33.6)	
1-2 years	92 (52.9)**	389 (43.3)	
3-4 years	41 (23.7)	323 (23.5)	
≥5 years	4 (2.3)	40 (3.5)	

Table 5: Study Participant Characteristics from 2020 and 2018 Surveys and 2019 OHSU Enrollment Data

	OHSU 2020 (n=175)[a]	OHSU 2018[4] (n=1133)[a]	OHSU 2019 Enrollment[61] (n=3017)[a]
International Student, n (%)	3 (1.7)	30 (2.7)	69(2.3)[e]
Race, n (%)[f]			
White	129 (74.1)	853 (75.3)	1999 (66.3)
Asian or Pacific Islander/Native Hawaiian	20 (11.5)	125 (11.0)	358 (11.9)
Multi-race	17 (9.8)	71 (6.3)	174 (5.8)
Other	3 (1.7)***	28 (2.5)	365 (12.1)[g]
Black	3 (1.7)	18 (1.6)	56 (1.9)
American Indian/Native Alaskan	2 (1.2)	11 (1.0)	10 (0.3)
Unknown/prefer not to answer	N/A	27 (2.4)	55 (1.8)
Ethnicity, n (%)			
Non-Hispanic/Latino	164 (93.7)***	1017 (89.8)	2679 (88.8)
Hispanic/Latino	11 (6.3)	85 (7.5)	283 (9.8)
Unknown/Prefer not to answer	N/A	31 (2.7)	55 (1.8)
Marital Status, n (%)			N/A
Single	98 (56.0)	608 (53.7)	
Married/Partnered	67 (38.3)	472 (41.7)	
Divorced	8 (4.6)**	3 (0.3)	
Separated	2(1.1)	7 (0.6)	
Widowed	N/A	3 (0.3)	
Number of Individuals in Household, mean ± SD			
	2.5 ± 0.9**	1.77 ± 1.3	N/A
Children in Household, n (%)			
Yes	19 (10.9)**	211 (18.6)	N/A
No	155(89.1)**	922 (81.4)	

Table 5: Study Participant Characteristics from 2020 and 2018 Surveys and 2019 OHSU Enrollment Data

	OHSU 2020 (n=175)[a]	OHSU 2018[4] (n=1133)[a]	OHSU 2019 Enrollment[61] (n=3017)[a]
Percentage of Household Income, mean percentage (± SD)		N/A[h]	N/A
Full or Part-time Job	28.9 ± 37.7		
Government Loans	25.8 ± 36.9		
Stipend from OHSU	17.5 ± 36.0		
Family Support	10.9 ± 23.8		
Scholarship	6.2 ± 19.1		
Savings	5.1 ± 15.2		
Public Loans	3.8 ± 15.0		
Other	1.7 ± 10.7		
Stipend from OHSU	17.5 ± 36.0		
OHSU Tuition Waiver Provided, n (%)	30 (17.1)	165 (14.4)	N/A

Data is reported as n (%) or mean ± SD. Astrics indicate significant differences between the 2020 sample and the 2018 sample and 2019 registration data ($p<0.05$). * = significant difference between 2020 data and both the 2018 data and 2019 registration data. ** = significant difference between 2020 data and 2018 data. *** = significant difference between 2020 data and 2019 registration data. Program of study was not compared to the 2019 registration data due to differences in categorization.

[a] n=175 for all variables unless stated otherwise. For data collected in 2020, n=174 for variables including race, number of individuals in the household, and children in the household. For data collected in 2018, n=1,128 for number of individuals in the household.

[b] The 2018 survey combined Medical School, Graduate Medicine Programs, Undergraduate Health Profession Programs, and Human Nutrition.

[c] Graduate Medicine Programs includes Human Nutrition and Physician Assistant programs.

[d] OHSU 2019 registration data does not include the College of Pharmacy joint programs.

[e] International student status is taken from 2018 registration data (n=2,999) due to missing 2019 data.

[f] OHSU 2019 enrollment data combines race/ethnicity.

[g] Other includes Hispanic/Latino, any race (n=283(9.8)) and non-resident Alien groups (n=82(2.7)).

[g] Represents income ≤$50,000

[h] Means ± SD for percentage of household income were only provided based of food security status rather than for the entire sample size.

Food Security Status

Food security status by academic program and race is summarized in Figures 4 and 5, respectively. Of the 175 respondents, 28 (27.4%) were classified as food insecure at both time points, 12 months before and 2-3 months after the stay-at-home mandate was issued. Food security status of 12 students (6.9%) changed from before the shelter-at-home mandate to after the shelter-at-home mandate. The proportion of students shifting from food secure to food insecure (n=6, 3.4%) and those shifting from food insecure to food secure (n=6, 3.4%) after the shelter-at-home mandate was not statistically significantly ($p>0.05$).

As summarized in Tables 6 and 7, when assessing the relationships between food security status and sociodemographic variables, no variables were significantly associated with food security status including gender, race, $\geq$ 3 years in current program, international student status, tuition waiver, ethnicity, marital status, annual pretax income, and presence of children in the household.

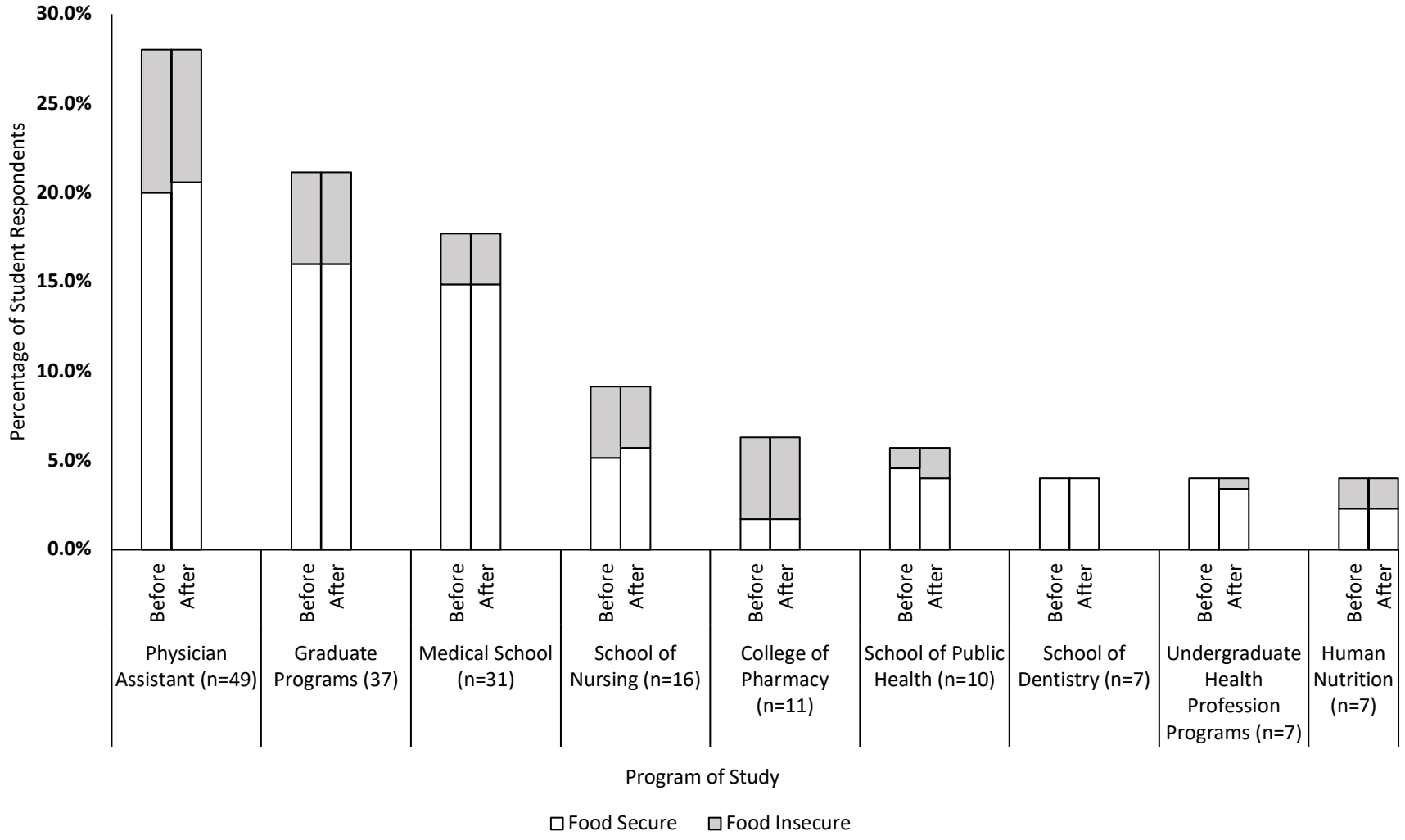

Figure 4. Percent of Students Classified as Food Secure or Food Insecure by Program of Study 12 Months Before and 2-3 Months After the Shelter-at-Home Mandate (n=175).

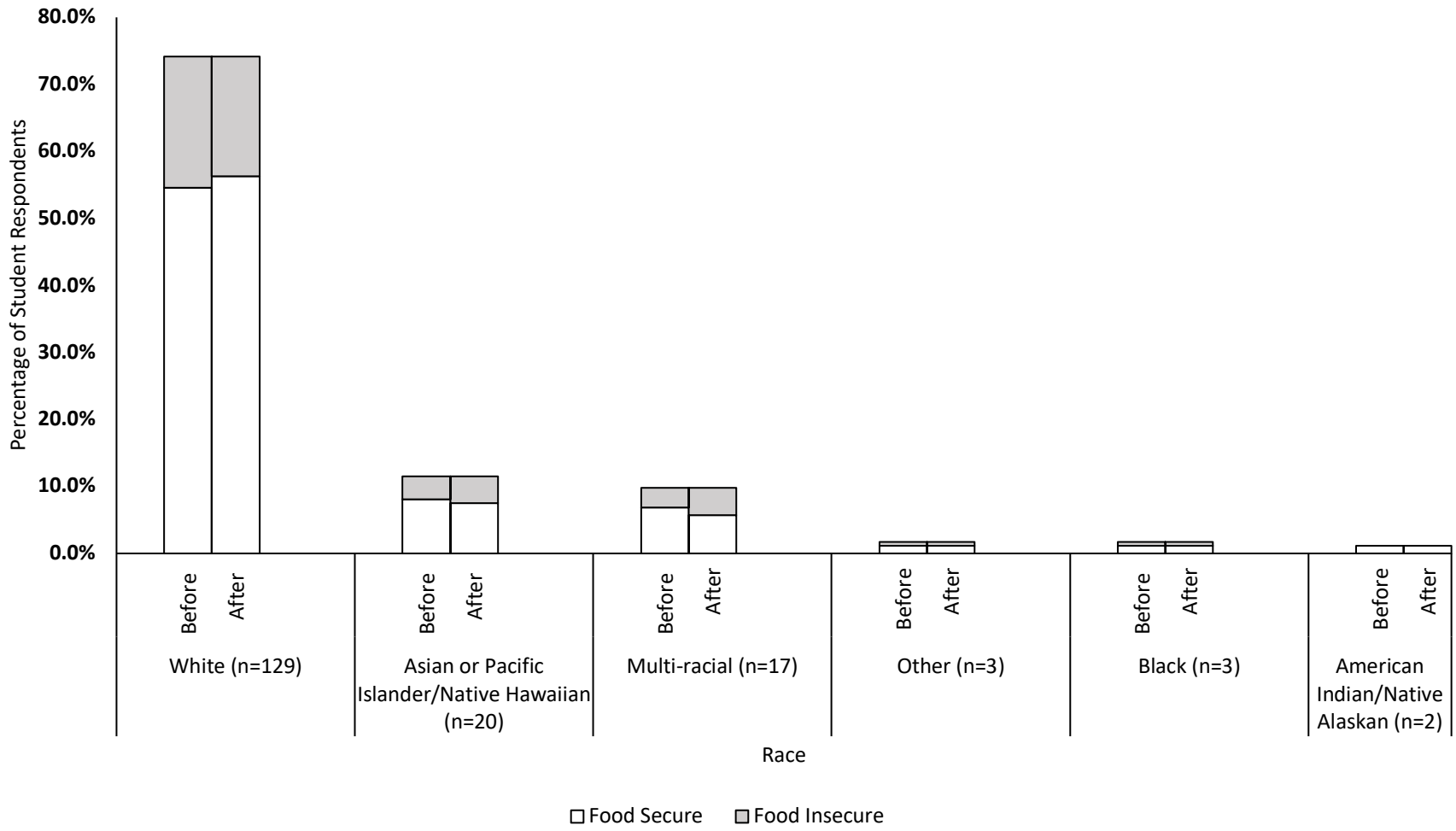

Figure 5: Percentage of Students Classified as Food Secure or Food Insecure by Race 12 Months Before and 2-3 Months After the Shelter-at-Home Mandate (n=174).

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Table 6: Associations Between Change in Food Security Status and Sociodemographic Variables (n=175)[a]

Characteristics	Maintained Status or Became Food Secure n (%)	Became Food Insecure n (%)	p[b]
Age <30 years			
Yes	110 (62.9)	6 (3.4)	0.098
No	59 (33.7)	0 (0)	
Gender (n=174)			
Female	135 (77.6)	6 (3.5)	0.621
Male	31 (17.8)	0 (0)	
Non-binary	1 (0.6)	0 (0)	
Transgender	1 (0.6)	0 (0)	
≥3 Years in Current Program (n=174)			
Yes	45 (25.9)	0 (0)	0.341
No	123 (70.7)	6 (3.5)	
International Student Status			
Yes	3 (1.7)	0 (0)	>0.05
No	166 (94.9)	6 (3.4)	
OHSU Tuition Waiver			
Yes	30 (17.1)	0 (0)	0.591
No	139 (79.4)	6 (3.4)	
Race (n=174)			
White	126 (72.4)	3 (1.7)	0.311
Asian or Pacific Islander/Native Hawaiian	19 (10.9)	1 (0.6)	
Multi-race	15 (8.6)	2 (1.15	
Other	3 (1.7)	0 (0)	
Black	3 (1.7)	0 (0)	
American Indian/Native Alaskan	2 (1.2)	0 (0)	
Hispanic/Latino			
Yes	11 (6.29)	0 (0)	>0.05
No	158 (90.3)	6 (3.4)	

Table 6: Associations Between Change in Food Security Status and Sociodemographic Variables (n=175)[a]

Characteristics	Maintained Status or Became Food Secure n (%)	Became Food Insecure n (%)	p[b]
Annual Pretax Income <$25,000			
Yes	79 (45.1)	4(2.3)	0.425
No	90 (51.4)	2 (1.1)	
Annual Pretax Income <$50,000			
Yes	124 (70.9)	6 (3.4)	0.340
No	45 (25.7)	0 (0)	
Children in Household (n=174)			
Yes	19 (10.9)	0 (0)	>0.05
No	149 (85.6)	6 (3.5)	

List of dichotomized sociodemographic variables that have been associated with food security status in past literature or in the 2018 survey results. Gender and race were not dichotomized due to having more than two categories. Change in food security status from 12 months before to 2-3 months after the shelter-at-home mandate was dichotomized into students who maintained their initial food security status or who became food secure 2-3 months after the shelter-at-home mandate and students who became food insecure 2-3 months after the shelter-at-home mandate.

[a] n=175 unless otherwise stated.

[b] All tests of association were conducted with a Fisher's Exact test based on expected values.

Table 7: Comparison of Proportions of Sociodemographic Variables between Those Who Became Food Insecure 2-3 Months After the Shelter-at-Home Mandate

Characteristics	Became Food Insecure n (%)	95% CI[a]	p
Age <30 years			
Yes (n=116)	6 (5.2)	0.0114-0.0920	0.0755
No (n=59)	0 (0)		
Gender[b]			
Female (n=141)	6 (4.3)	0.01577-0.9032	
Male (n=31)	0 (0)	0-0.1122	
Non-binary (n=1)	0 (0)	0-0.975	
Transgender (n=1)	0 (0)	0-0.975	
≥3 Years in Current Program			
Yes (n=45)	0 (0)	0.0102-0.0828	0.1410
No (n=129)	6 (4.7)		
International Student Status			
Yes (n=3)	0 (0)	0.0075-0.0623	0.7420
No (n=172)	6 (3.5)		
OHSU Tuition Waiver			
Yes (n=3)	0 (0)	0.0075-0.0623	0.7420
No (n=172)	6 (3.5)		
Race[c]			
Multi-race (n=17)	2 (11.8)	0.0146-0.3644	
Asian or Pacific Islander/Native Hawaiian (n=20)	1 (5.0)	0.0013-0.2487	
White (129)	2 (2.3)	0.0048-0.0665	
Other (n=3)	0 (0)	0-0.7076	
Black (n=3)	0 (0)	0-0.7076	
American Indian/Native Alaskan (n=2)	0 (0)	0-0.8419	

Table 7: Comparison of Proportions of Sociodemographic Variables between Those Who Became Food Insecure 2-3 Months After the Shelter-at-Home Mandate

Characteristics	Became Food Insecure n (%)	95% CI[a]	p
Single/Separated/Divorced			
Yes (n=108)	5 (4.6)	-0.0177-0.0805	0.2671
No (n=67)	1 (1.5)		
Annual Pretax income <$25,000			
Yes (n=83)	4 (4.8)	-0.0284-0.0814	0.3359
No (n=92)	3 (2.2)		
Annual Pretax Income <$50,000			
Yes (n=130)	6 (4.6)	0.0101-0.0823	0.1423
No (n=45)	0(0)		
Children in Household			
Yes (n=19)	6 (3.9)	0.0083-0.0691	0.3828
No (n=155)	0 (0)		

List of dichotomized sociodemographic variables that were associated with food security status published in literature or in the 2018 survey results. Gender and race were not dichotomized due to having more than two categories. Change if food security status from 12 months before to 2-3 months after the shelter-at-home mandate was dichotomized into students who maintained their current food security status or who became food secure 2-3 months after the shelter-at-home mandate and students who became food insecure 2-3 months after the shelter-at-home mandate.

[a] Two-sample, two-sided test of proportions was completed for dichotomized sociodemographic variables.

[b,c] A 95% CI: and a one-sided 97.5% CI were calculated for demographic variables with multiple categories.

Comparison of Food Security Prevalence

Prevalence of food insecurity among OHSU students in 2018 and nationally among US households in 2019 was reported to be 28.5% and 10.5%, respectively. These proportions were compared to the prevalence of food insecurity among OHSU students before and after the shelter-at-home mandate (27.4%). There was no significant difference in the prevalence of students who were food insecure 12 months before and 2-3 months after the stay-at-home-mandate compared to the prevalence of students classified as food insecure in 2018 (95% CI: -8.3% - 6.1%, $p=0.7650$). When comparing the proportion of students who were food insecure to the 2019 national data, there was a significant difference ($p<0.001$); the percentage of students who were food insecure at OHSU was 16.9% higher than the 2019 household average 12 months before and 2-3 months after the shelter-at-home mandate. This significant difference indicates that the prevalence of food insecurity among OHSU students was 20.8% to 34.0% higher 12 months before ad 2-3 months after the COVID-19 pandemic than the 2019 national household average.

University and Community Food Resource Use

Out of 175 responses, 171 (97.7%) and 164 (93.7%) indicated their use of university food resources 12 months before and 2-3 months after the shelter-at-home mandate, respectively. Twelve months before the shelter-at-home mandate, the most used university food resources were on-campus free meals/snacks and on-campus food vendor discounts (Figure 6). Seventy-five (43.9%) of those who responded used a community food resource but did not use a university resource. Other university resources used at this time included university resources from other campuses including Portland State University and Oregon State University (Pharmacy students in their first year of their program complete course work at Oregon State

University). After the shelter-at-home mandate was enacted, most students who responded (84.8%) did not use a university food resource. The meal-in-a-bag program became the university food resource most commonly used after the shelter-at-home mandate (Figure 6). Other university resources used by students during the pandemic included OHSU food deliveries, a component of the meal-in-the-bag program, and the Oregon State University food pantry. Figure 7 summarizes food pantry items students requested for the future.

Of the 175 students included in this analysis, 163 (93.1%) responded to both university resource use questions. Ninety-seven (56.3%) students used at least one university resource 12 months before the stay-at-home mandate was issued and 25 (15.2%) students used at least one university resource 2-3 months after the stay-at-home mandate was issued. A total of 69 (40.8%) students changed their university food resource use from before the shelter-at-home mandate to after the shelter-at-home mandate. The difference in the percentage of students who used at least one university food resource before the shelter-at-home mandate to not using any university food resource after the shelter-at-home mandate (41.1%) compared to the students who did not use any university food resource before the shelter-at-home mandate to using at least one university food resource after the shelter-at-home mandate (1.2%) was statistically significantly ($p<0.001$). When comparing student sociodemographic factors (Table 8 and 9), being in their academic program for ≥3 years was associated with change in university food resource use ($p=0.025$). A higher proportion of those in their program for ≥3 years (55.8%) went from using at least one university food resource before to using no university food resource after the shelter-at-home mandate compared to 36.1% of students in their programs for <3 years (95% CI: 0.0251-0.3685, $p=0.0247$).

Among 169 (94.9%) students who responded to the use of community food resource question, 91.1% of students responded that they did not use a community food resource 12 months before the shelter-at-home mandate. Of those who did use a community food resource, the Oregon Food Bank, the Portland State University Harvest Share, and SNAP were the most commonly used community food resources. After the shelter-at-home mandate, there was an increase in the use of SNAP and unemployment insurance as shown in Figure 8. "Other" community food resources described by students after the shelter-at-home mandate included grocery bag delivery services from local grocery stores and accessing food through friends/families with gardens. Figure 9 summarizes non-food related resources students had difficulty accessing 2-3 months after the shelter-at-home mandate by food security status.

Of the 175 students who responded to the survey, 166 (94.8%) students responded to both community food resource questions and were included in this analysis. Seventeen students (10.1%) used at least one community resource 12 months before and 26 students (15.4%) used at least one community resource 2-3 months after the stay-at-home mandate, with a total of 19 students (11.4%) changing their community food resource use status. The difference in proportion of students who used at least one community resource before the shelter-at-home mandate and no community food resources after the shelter-at-home mandate (3.0%) to the proportion of students who used no community food resources before the shelter-at-home mandate and at least one after the shelter-at-home mandate (8.4%) was not statistically significantly ($p=0.0639$). When comparing sociodemographic factors, there were no significant differences associated with change in community food resource use (Table 8 and 9).

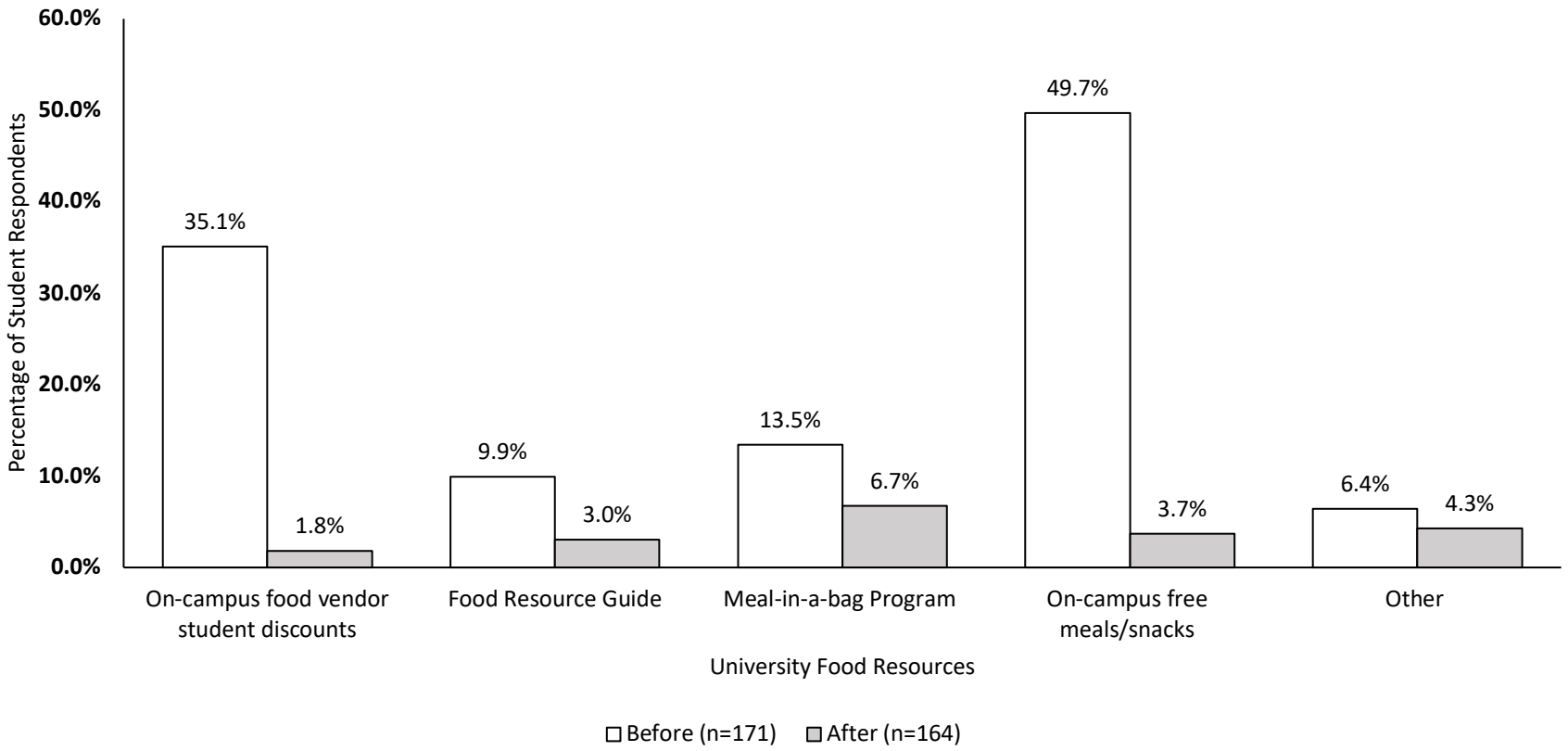

Figure 6. Use of University Food Resources 12 Months Before and 2-3 Months After the Shelter-at-Home Mandate.

Percentages do not add up to being 100% as respondents could respond to using more than 1 type of university resource. A total of 43.9% and 84.8% of students did not use a university food resource before or after the shelter-at-home mandate, respectively. Other common food resources used by students included non-OHSU university food pantries and OHSU food delivery services.

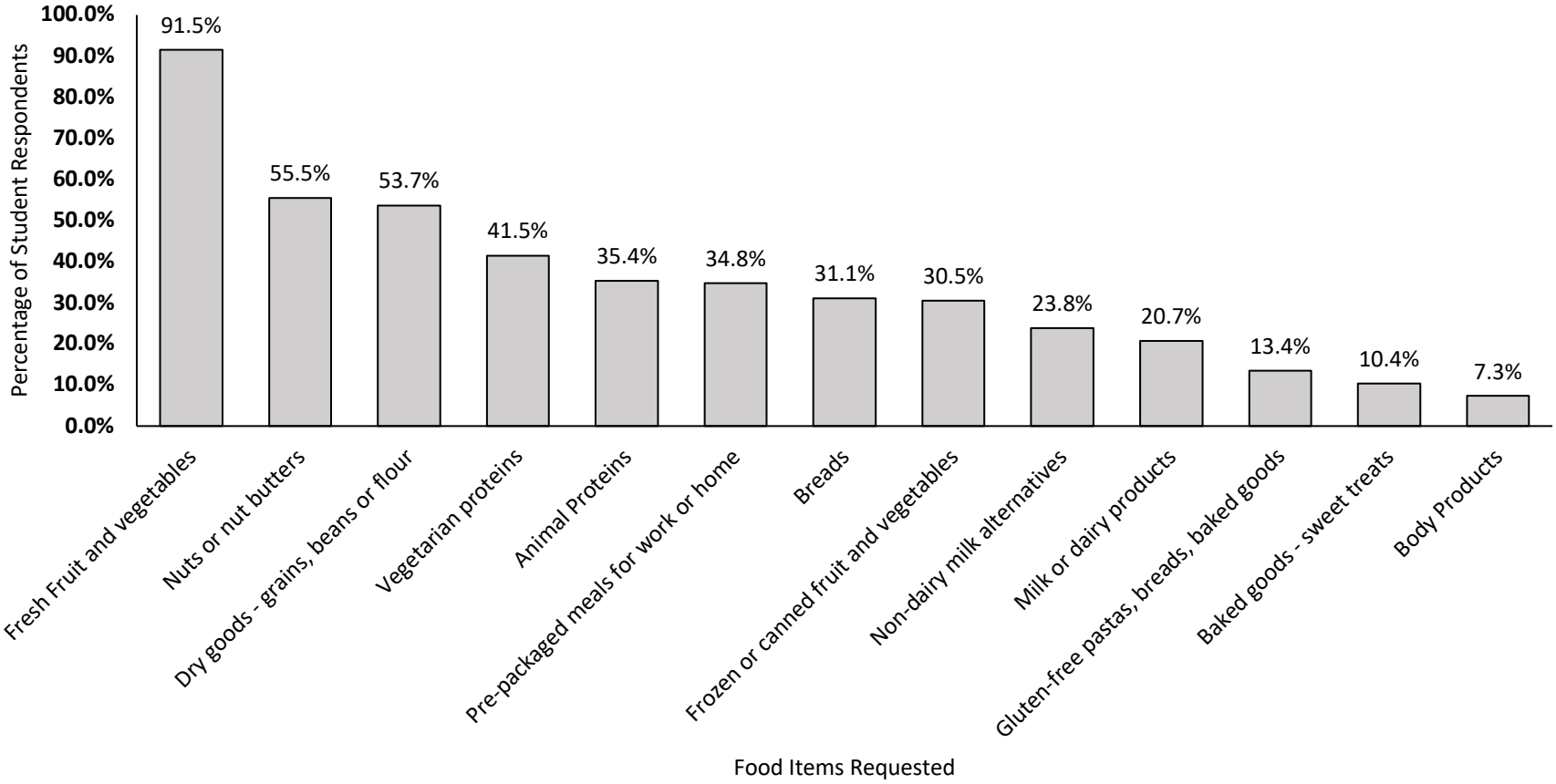

Figure 7. Items Requested for Future On-Campus Food Pantry (n=164).

Percentages do not add up to 100% as respondents could respond to interest in more than 1 food pantry item.

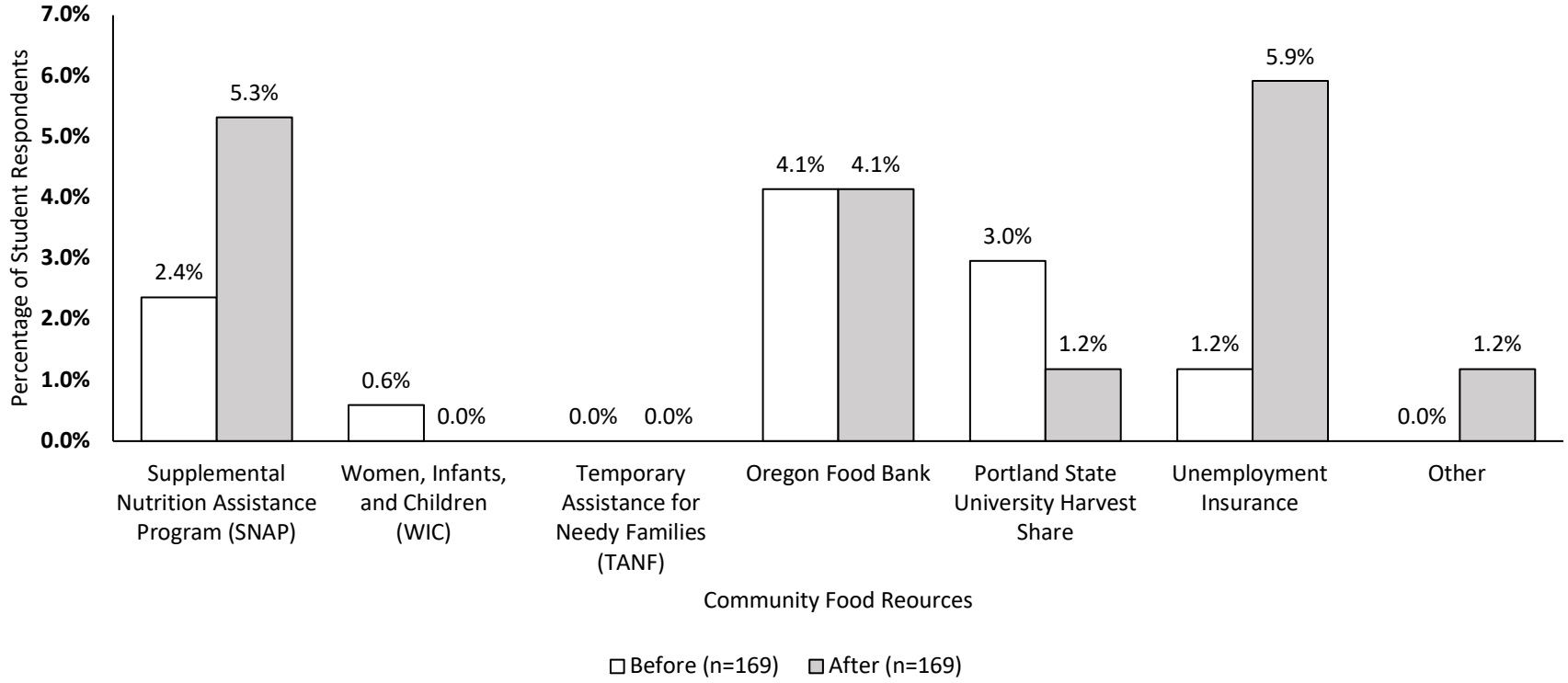

Figure 8. Use of Community Food Resources 12 Months Before and 2-3 Months After the Shelter-at-Home Mandate.

Percentages do not add up to 100% as respondents could respond to using more than 1 type of community resource. A total of 91.1% and 85.8% of students did not use a community food resource before or after the shelter-at-home mandate, respectively. Other common food resources used by students included grocery bag delivery services and donations from friends/families with gardens.

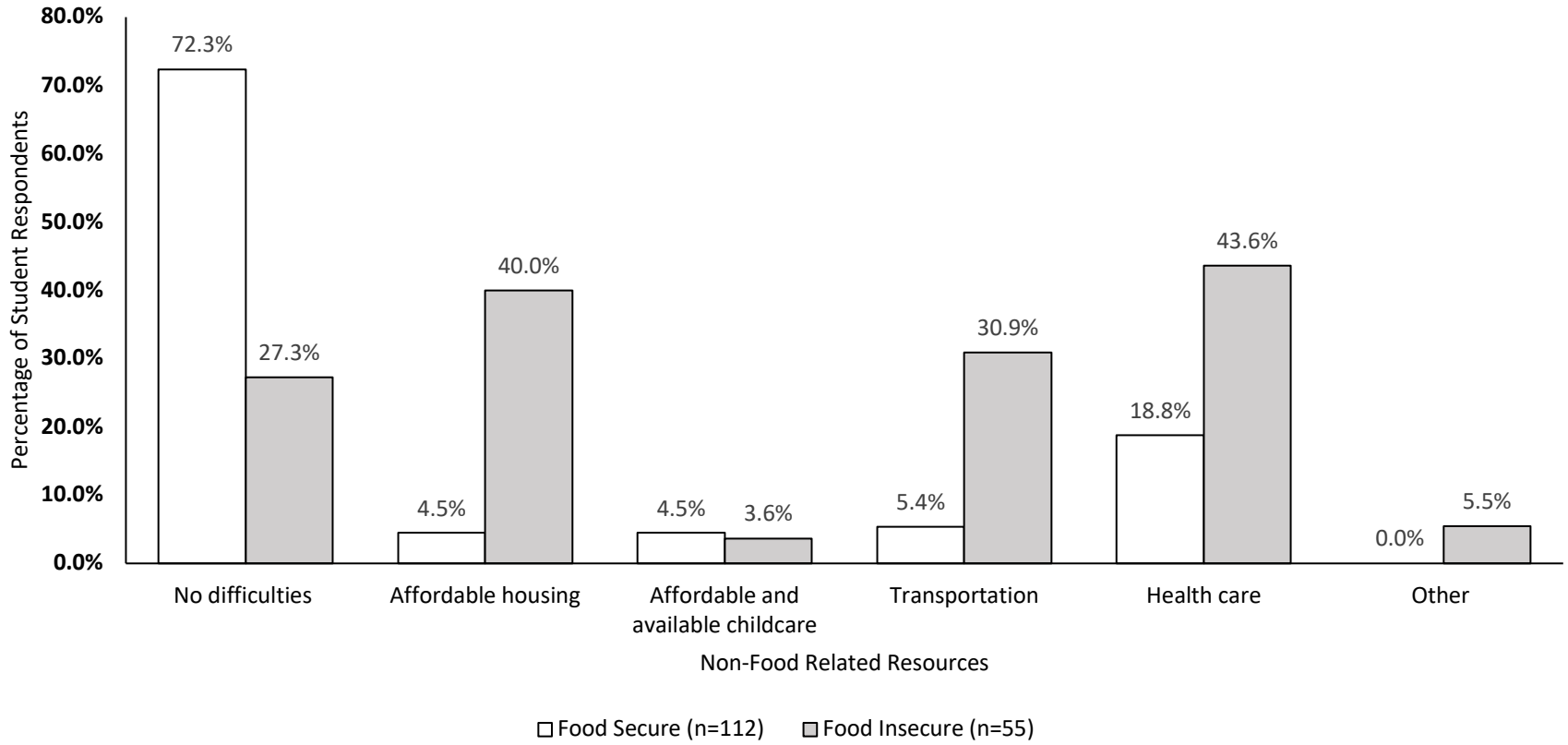

Figure 9. Non-Food Related Resources Students Reported Difficulty Accessing After the Shelter-at-Home Mandate by Food Security Status (n=167).

Percentages will not add up to being 100% as respondents could respond to difficulty accessing more than 1 additional resource.

Table 8: Association between Change in Community or University Food Resource Use from 12 Months Before to 2-3 Months After the Shelter-at-Home Mandate and Sociodemographic Variables (n=175)[a]

	University Food Resource			Community Food Resource		
Characteristics	**Maintained resource use or started using ≥1 resource n (%)**	**Switched from using ≥1 resource to none n (%)**	**p[b]**	**Maintained resource use or started using ≥1 resource n (%)**	**Switched from using ≥1 resource to none n (%)**	**p[b]**
Age <30 years[c]						
Yes	58 (35.6)	48 (29.5)	0.139	107 (65.5)	3 (1.8)	1.000
No	38 (23.3)	19 (11.7)		54 (32.5)	2 (1.2)	
Gender[d]						
Female	80 (49.4)	53 (32.7)	0.522	132 (80.0)	4 (2.4)	1.000
Male	14 (8.6)	13 (8.0)		26 (15.8)	1 (0.6)	
Non-binary	0 (0)	1 (0.6)		1 (0.6)	0 (0)	
Transgender	1 (0.6)	0 (0)		1 (0.6)	0 (0)	
≥3 Years in Current Program[d]						
Yes	19 (11.7)	24 (14.8)	0.025	40 (24.2)	2 (1.2)	0.602
No	76 (46.9)	43 (26.5)		120 (72.7)	3 (1.8)	
International Student Status[c]						
Yes	2 (1.2)	1 (0.6)	1.000	3 (1.8)	0 (0)	1.000
No	94 (57.7)	66 (40.5)		158 (95.2)	5 (3.0)	
OHSU Tuition Waiver[c]						
Yes	12 (7.4)	16 (9.8)	0.058	29 (17.5)	0 (0)	0.588
No	84 (51.5)	51 (31.3)		132 (79.5)	5 (3.0)	
Race[d]						
White	69 (42.6)	51 (31.5)	0.862	118 (71.5)	5 (3.0)	1.000
Asian or Pacific Islander/Native Hawaiian	12 (7.4)	5 (3.1)		17 (10.3)	0 (0)	
Multi-race	10 (6.2)	2 (1.2)		17 (10.3)	0 (0)	
Other	2(1.2)	1 (0.6)		3 (1.8)	0 (0)	
Black	1 (0.6)	2 (1.2)		3 (1.8)	0 (0)	

Table 8: Association between Change in Community or University Food Resource Use from 12 Months Before to 2-3 Months After the Shelter-at-Home Mandate and Sociodemographic Variables (n=175)[a]

	University Food Resource			Community Food Resource		
Characteristics	**Maintained resource use or started using ≥1 resource n (%)**	**Switched from using ≥1 resource to none n (%)**	**p[b]**	**Maintained resource use or started using ≥1 resource n (%)**	**Switched from using ≥1 resource to none n (%)**	**p[b]**
Hispanic/Latino[c]						
Yes	4 (2.5)	5 (3.1)	0.490	9 (5.4)	1 (0.6)	0.270
No	92 (56.4)	62 (38.0)		152 (91.6)	4 (2.4)	
Single/Separated/Divorced[c]						
Yes	59 (36.2)	41 (25.2)	0.973	97 (58.4)	5 (3.0)	0.072
No	37 (22.7)	26 (16.0)		64 (38.6)	0 (0)	
Annual Pretax income ≤$25,000[c]						
Yes	50 (30.7)	28 (17.2)	0.196	77 (46.4)	2 (1.2)	1.000
No	46 (28.2)	39 (23.9)		84 (50.6)	3 (1.8)	
Annual Pretax Income ≤$50,00[c]						
Yes	64 (39.3)	54 (33.1)	0.050	118 (71.1)	5 (3.0)	0.329
No	32 (19.6)	13 (8.0)		43 (25.9)	0 (0)	
Children in Household[e]						
Yes	14 (8.6)	4 (2.5)	0.080	18 (10.9)	0 (0)	1.000
No	81 (50.0)	63 (63)		142 (86.1)	5 (3.0)	

List of dichotomized sociodemographic variables associated with food security status as reported in published literature or in the 2018 survey results. Gender and race were not dichotomized due to having more than two categories. Change in food resource use from 12 months before to 2-3 months after the shelter-at-home mandate was dichotomized into students who maintained their food resource use or started using at least one food resource 2-3 months after the shelter-at-home mandate and students who used at least one food

resource 12 months before the shelter-at-home mandate and then stopped using any food resource 2-3 months after the shelter-at-home mandate.

[a] n=175 unless otherwise stated.

[b] Tests of association were conducted using Fisher's Exact tests based on expected values.

[c] n=163 for university resources, n=166 for community resources.

[d] n=162 for university resources, n=165 for community resources.

[e]n=162 for university resources, n=166 for community resources.

Table 9: Comparison of Proportions between Sociodemographic Variables and Students Using ≥1 Food Resource 12 Months Before to No Food Resource 2-3 Months After the Shelter-at-Home Mandate

	University Food Resource Use			Campus Food Resource Use		
Characteristics[a]	**Switched from using ≥1 resources to none n (%)**	**95% CI**	**p[b]**	**Switched from using ≥1 resources to none n (%)**	**95% CI**	**p[b]**
Age <30 years						
Yes (n=106), (n=110)	48 (45.3)	-0.0353-0.2743	0.1392	3 (2.7)	-0.0489-0.0657	0.7647
No (n=57), (n=56)	19(33.3)			2 (3.6)		
Gender[c]						
Female (n=133), (n=136)	53 (39.9)	0.3147-0.4870		4 (2.9)	0.0081-0.0736	
Male (n=27)	13 (48.2)	0.2867-0.6805		1 (3.7)	0.0009-0.1897	
Non-binary (n=1)	1 (100.0)	0.025-1		0 (0)	0-0.975	
Transgender (n=1)	0 (0)	0-0.975		0 (0)	0-0.975	
≥3 Years in Current Program						
Yes (n=43), (n=42)	24 (55.8)	0.0251-0.3685	0.0247	2 (4.8)	-0.0931-0.0467	0.4489
No (n=119), (n=123)	43 (36.1)			3 (2.4)		
International Student Status						
Yes (n=3)	1 (33.3)	-0.6180-0.4596	0.7824	0 (0)	0.0042-0.0572	0.7580
No (n=160), (n=163)	66 (41.3)			5 (3.1)		
OHSU Tuition Waiver						
Yes (n=28), (n=29)	16 (57.1)	-0.3943-0.0071	0.0581	0 (0)	0.0051-0.0679	0.2962
No (n=135), (n=137)	51 (37.8)			5 (3.7)		

Table 9: Comparison of Proportions between Sociodemographic Variables and Students Using ≥1 Food Resource 12 Months Before to No Food Resource 2-3 Months After the Shelter-at-Home Mandate

	University Food Resource Use			Campus Food Resource Use		
Characteristics	**Switched from using ≥1 resources to none n (%)**	**95% CI**	**p[b]**	**Switched from using ≥1 resources to none n (%)**	**95% CI**	**p[b]**
Race[d]						
White (n=120), (n=123)	51 (42.5)	0.3353-0.5185		5 (4.1)	0.0133-0.0923	
Asian or Pacific Islander/Native Hawaiian (n=17)	5 (29.4)	0.1031-0.5596		0 (0)	0-0.1951	
Multi-race (n=17)	7 (41.2)	0.1844-0.6708		0 (0)	0-0.1951	
Other (n=3)	1 (33.3)	0.0084-0.9057		0 (0)	0.7076	
Black (n=3)	2 (66.7)	0.0943-0.9914		0 (0)	0.7076	
American Indian/Native Alaskan (n=2)	1 (50.0)	0.0126-0.9874		0 (0)	0-0.8419	
Hispanic/Latino						
Yes (n=9), (n=10)	5 (55.6)	-0.1807-0.4867	0.3645	1 (10.0)	-0.1131-0.2620	0.1818
No (n=154), (n=156)	62 (40.3)			4 (2.6)		
Single/Separated/Divorced						
Yes (n=100), (n=102)	41 (41.0)	-0.1579-0.1525	0.9720	5 (4.9)	0.0071-0.0909	0.0722
No (n=63), (n=64)	41.3 (41.3)			0 (0)		
Annual Pretax income ≤$25,000						
Yes (n=78), (n=79)	28 (35.9)	-0.2500-0.0505	0.1958	2 (2.5)	-0.0609-0.0425	0.7291
No (n=85), (n=87)	3 (45.9)			3 (3.5)		

Table 9: Comparison of Proportions between Sociodemographic Variables and Students Using ≥1 Food Resource 12 Months Before to No Food Resource 2-3 Months After the Shelter-at-Home Mandate

	University Food Resource Use			Campus Food Resource Use		
Characteristics	**Switched from using ≥1 resources to none n (%)**	**95% CI**	**p[b]**	**Switched from using ≥1 resources to none n (%)**	**95% CI**	**p[b]**
Annual Pretax Income ≤$50,000						
Yes (n=118), (n=123)	54 (45.8)	0.0086-0.3288	0.0504	5 (4.1)	0.0058-0.0756	0.1792
No (n=45), (n=43)	13(28.9)			0 (0)		
Children in Household						
Yes (n=18)	4 (22.2)	0.0069-0.4237	0.0803	0 (0)	0.0047-0.0633	0.4269
No (n=144), (n=147)	63 (43.8)			5 (3.4)		

List of dichotomized sociodemographic variables associated with food security status in reported published literature or in the 2018 survey results. Gender and race were not dichotomized due to having more than two categories. Change in food resource use from 12 months before to 2-3 months after the shelter-at-home mandate was dichotomized into students who maintained their food resource use or started using at least one food resource 2-3 months after the shelter-at-home mandate and students who used at least one food resource 12 months before the shelter-at-home mandate and then stopped using any food resource 2-3 months after the shelter-at-home mandate.

[a] For each characteristic, the first n represents the number of respondents under university food resource use. The second n represents the number of respondents under community food resource use. If only one n is included next to its respective characteristic, the number of respondents is the same for both university and community food resource use.

[b] Two-sample, two-sided test of proportions was only completed for dichotomized sociodemographic variables.

[c,d] A 95% CI and a one-sided 97.5% CI were calculated for gender and race demographics with multiple categories.

Student Response Behaviors and Coping Strategies Used During COVID-19

Food security status was significantly associated with all response behaviors (Table 10) including food-related stress ($p<0.001$), motivation to cook healthy ($p=0.040$), quality of foods purchased ($p=0.001$), and accessing non-food resources ($p<0.001$). A higher proportion of students who were food insecure reported experiencing food-related stress (66.0%) compared to food secure students (8.1%) with a significant difference in proportions (95% CI: 43.5% - 72.3%, $p<0.001$). There was also a significant difference in proportions (Table 11) with more students who were food insecure reporting less motivation to cook healthy (95% CI: 0.8% - 34.0%, $p=0.038$), reduced quality of foods purchased (95% CI: 20.7% - 52.3%, $p<0.001$), and difficulty accessing non-food resources (95% CI: 43.3% - 69.8% $p<0.001$).

Food security status was also associated with certain coping strategies (Table 10) including leaving the home less often impacted amount of food needed in the home ($p<0.001$) and likeliness to use a future on-campus food pantry ($p<0.001$). A higher proportion of students who were food insecure (64.1%) reported that leaving the home less often to purchase food in response to COVID-19 did impact the amount of food needed compared to food secure students (15.7%) with a significant difference in proportions (95% CI: 31.8% - 65.0%, $p<0.001$). Additionally, a higher proportion of students who were food insecure reported being more likely to use a future on-campus food pantry (89.6%) compared to food secure students (48.3%) with a significant difference in proportions (95% CI: 28.8% - 53.7%, $p<0.001$). Weekly grocery store expenses, leaving the home less often to grocery shop not in relation to amount of food needed, not purchasing extra food, and less food preparation were not significantly different between students who were food secure and those who were food insecure (Table 11).

Table 10: Associations Between Food Security Status and Response Behaviors and Use of Coping Strategies 2-3 Months After the Shelter-at-Home Mandate

	Yes to Response Behavior or Coping Strategies		No to Response Behavior or Coping Strategies			
	Food Secure n (%)	**Food Insecure n (%)**	**Food Secure n (%)**	**Food Insecure n (%)**	**χ^2**	**p[a]**
Food-related stress (n=171)	10 (5.9)	31 (18.1)	114 (66.7)	16 (9.4)	62.6671	<0.001
Less motivation to cook healthy (n=171)	47 (27.5)	26 (15.20)	77 (45.0)	21 (12.3)	4.2253	0.040
Reduced quality of foods purchased (n=169)	38 (22.5)	31 (18.3)	85 (50.3)	15 (8.9)	18.4593	0.001
Difficulty accessing non-food resources[b] (n=167)	34 (20.4)	38 (22.8)	88 (52.7)	7 (4.2)	42.9033	<0.001
≤$50/week spent on groceries (n=175)	19 (10.9)	13 (7.43)	108(61.7)	35 (20.0)	3.4261	0.064
Leaving the home less often to grocery shop[c] (n=167)	95 (56.9)	42 (25.2)	25 (15.0)	5 (13.0)	2.3819	0.123
Leaving the home less often impacted amounts of food needed (n=141)	16 (11.4)	25 (17.7)	86 (61.0)	14 (9.9)	32.0688	<0.001

Table 10: Associations Between Food Security Status and Response Behaviors and Use of Coping Strategies 2-3 Months After the Shelter-at-Home Mandate

	Yes to Response Behavior or Coping Strategies		No to Response Behavior or Coping Strategies			
	Food Secure n (%)	**Food Insecure n (%)**	**Food Secure n (%)**	**Food Insecure n (%)**	χ^2	**p[a]**
Likely to use on-campus food pantry (n=168)	58 (34.5)	43 (25.6)	62 (36.9)	5 (3.0)	24.3323	<0.001
Less food preparation (n=171)	8 (4.7)	7 (4.1)	116 (67.8)	40 (23.5)	3.0352	0.126

Response Behaviors and Coping Strategies were dichotomized based on yes/no and Likert scale questions.

[a] Tests of association were completed with a chi-square test based on exact values.

[b] Non-food resources refers to resources including housing, childcare, and transportation.

[c] Leaving the home less often to grocery shop is in reference to leaving the home less often due to COVID-19 and fear of exposure to the virus.

[d] If students responded yes to this question, they were asked a follow-up question to determine if leaving the home less often impacted the food they needed in the home.

Table 11: Comparison of Proportions of Food Secure and Food Insecure Students by Response Behaviors and Coping Strategies 2-3 Months After the Shelter-at-Home Mandate

	Yes to Response Behavior or Coping Strategy n (%)	p	95% CI
Food-related stress			
Food Secure (n=124)	10 (8.1)	<0.001	0.4354-0.7226
Food Insecure (n=47)	31 (66.0)		
Less motivation to cook healthy			
Food Secure (n=124)	47 (37.9)	0.0398	0.0084-0.3400
Food Insecure (n=47)	26 (55.3)		
Reduced quality of foods purchased			
Food Secure (n=123)	38 (30.9)	<0.001	0.2068-0.5232
Food Insecure (n=46)	31 (67.4)		
Difficulty accessing non-food resources[a]			
Food Secure (n=122)	34 (27.9)	<0.001	0.4332-0.6982
Food Insecure (n=45)	38 (84.4)		
≤$50/week spent on groceries			
Food Secure (n=127)	19 (15.0)	0.0642	-0.2614-0.0190
Food Insecure (n=48)	13 (27.1)		
Leaving the home less to grocery shop[b]			
Food Secure (n=120)	95 (79.2)	0.1229	-0.2161-0.0123
Food Insecure (n=47)	42 (89.4)		
Leaving the home less impacts amount of food needed[c]			
Food Secure (n=102)	16 (15.7)	<0.001	0.3178-0.6504
Food Insecure (n=39)	25 (64.1)		
Purchasing less extra food			
Food Secure (n=124)	29 (23.4)	0.4646	-0.0969-0.2069
Food Insecure (n=45)	13 (28.9)		

Table 11: Comparison of Proportions between Food Secure and Food Insecure Students by Response Behaviors and Coping Strategies 2-3 Months After the Shelter-at-Home Mandate

	Yes to Response Behavior or Coping Strategy	p	95% CI
Less food preparation			
Food Secure (n=124)	8 (6.5)	0.0815	-0.1950-0.0262
Food Insecure (n=47)	7 (14.9)		

Response Behaviors and Coping Strategies were dichotomized based on yes/no and Likert scale questions.

[a] Non-food resources refers to resources including housing, childcare, and transportation.

[b] Leaving the home less to grocery shop is in reference to leaving the home less due to COVID-19 and fear of exposure to the virus.

[c] If students responded “yes” to this question, they were asked a follow-up question to determine if leaving the home less impacted the food they needed. Students who responded “no” skipped this follow-up question.

Qualitative Analysis

Free response questions were coded to answer the following question (Figure 10):[69]

"Is there any additional information that you would like us to know about your ability to access food or recommendations that you have for OHSU to improve your access to food?"

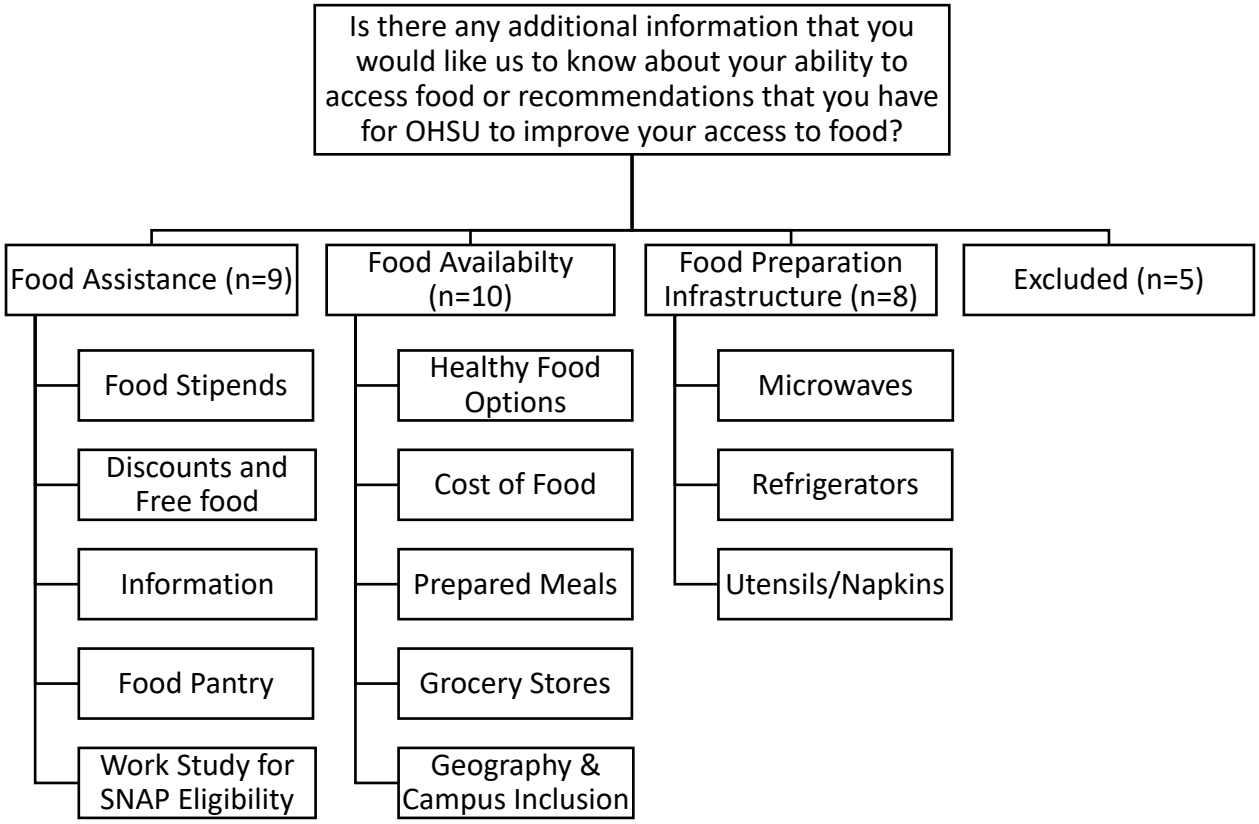

Figure 10. Coding Decision Tree for Qualitative Analysis.

A total of 4 codes were used to characterize student responses: food assistance, food availability, food preparation infrastructure, and those excluded due to lack of relevance (30 free response questions). Students' responses could be included in more than one coding category. Descriptions of the responses are summarized below each code.

A total of 30 students responded to the free response question. Analysis was limited to responses indicating recommendations to OHSU for improving food access; five (16.7%) responses were excluded for not addressing this question. Inductive analysis of responses indicated correspondence between identified needs and the Committee on World Food Security's six dimensions of food security, which include food access and availability. Responses aligned with personal circumstances that did not address what OHSU could do to improve food access and availability.[69] The definition of food access and availability as defined by the Committee on World Food Security's six dimensions of food security are provided in Appendix F.

Nine students' replies (30%) qualified as food access-related responses. Students reported the need for additional university food stipends, discounts and free food options, an on-campus food pantry, more opportunities for work to qualify for federal resources such as SNAP, and additional food resource information. The following response is indicative of the desire for an on-campus food pantry:

> "Having access to a food pantry for the times when money is short to buy food would be very helpful. Having a signup sheet online for quick pick up could also help limit exposure during COVID-19."

Current food discounts at OHSU, which provide 10% off retail price, were reported to not be enough:

> "A free or significantly reduced-cost lunch program for OHSU students would greatly reduce student stress. A 10-20 % discount however is not enough to help!"

Eight (26.7%) students reported the need for additional food availability at OHSU. Common recommendations included increased healthy food options, reduced cost of food, access to

prepared/prepackaged meals, more grocery store options around campus, and inclusion of all OHSU campus locations (regional and rural campuses in the state and main campuses in Portland) when making food availability changes. Grocery stores near campus also appeared to be a limiting factor for students:

> "Near to South waterfront, there is no grocery store and it cause[s] me to take 2 hours with the public transportation to go to the target/safeway to buy food. I wonder as in the South waterfront area, there are many buildings and apartments that students are living there, that would be great if the new grocery store will be opened."

Transportation in relation to food availability was also a concern:

> "The lack of grocery stores and affordable food options around the south waterfront are a big barrier in access to food. Without a car it is super challenging to have regular access to purchasing food. Our school schedules also made it difficult to find time to go grocery shopping and for food prep. The fridges in RLSB are always overly full and at an unsafe food storage temp. The long lines to heat up lunches also posed a barrier to types of foods to bring to campus."

Lastly, 10 students (33.3%) discussed ways to improve food storage and preparation on campus including the addition of microwaves, refrigerators, utensils, and napkins. Microwaves were a popular recommendation by students:

> "Microwaves that students can access is huge, even for those who can afford food, it is often cheaper and necessary to bring foods to campus based on dietary preference and there is very poor storage and or heating options available!!!!"

Additional food storages options included the addition of refrigerators close to classes:

"It would be nice if there were more student friendly refrigerators on the hill. Most of the time it limits my sack lunch options because I don't have time to run across campus and back to grab something from the student locker room in SJH [Sam Jackson Hall] during clinicals."

Student responses to the open-ended survey question were illustrative of the campus resources students indicated they would like to see as a response to other survey questions (Figure 11).

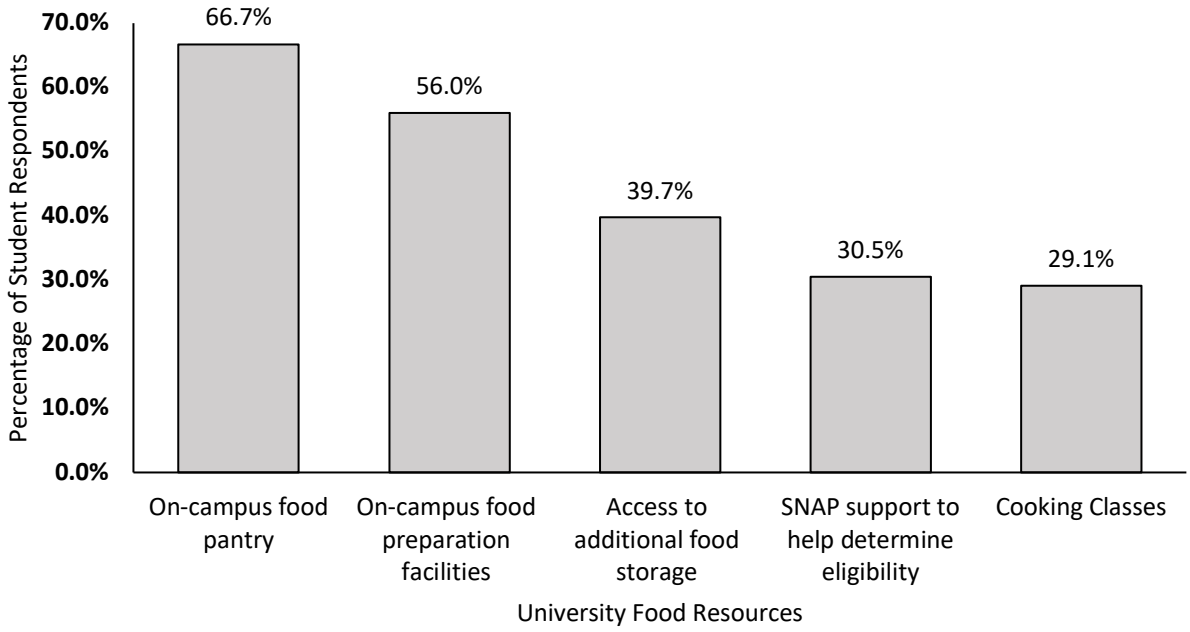

Figure 11. University Food Resources Desired by OHSU Students (n=141).

Percentages do not add up to 100% as students could report more than 1 additional campus resource.

CHAPTER 5: DISCUSSION

This research generated interesting results regarding food insecurity status, university and community food resource use, and response behaviors experienced and coping strategies used amid the COVID-19 pandemic. The percentage of OHSU students identified as food insecure was not different 2-3 months after the initiation of the shelter-at-home mandate than 12 months before, despite a decrease in university food resource use as a result of the shelter-at-home mandate. Some of the most interesting results were that students who were food insecure more frequently reported specific response behaviors and coping strategies used 2-3 months after the shelter-at-home mandate than students who were food secure. While the prevalence of food insecurity was not different from 2018 values, prevalence of food insecurity remains high compared to national data confirming that students enrolled in professional and graduate programs are a high-risk group with unique risk factors that contribute to their high rate of food insecurity.

The results reported here suggest that food security status before the pandemic was not different from 2018 or following the shelter-at-home mandate in response to the COVID-19 pandemic. This finding was not expected. What was expected was the rate of food insecurity would increase with more students who were classified as food secure prior to the pandemic becoming food insecure 2-3 months after the shelter-at-home mandate. Limited research has been published describing food security status among university students during the COVID-19 pandemic. One cross-sectional survey of university students in the state of Texas identified that 34.5% of students were food insecure following the pandemic.[64] In this sample, students who were food insecure were more likely to have living arrangements, employment, and income impacted by the COVID-19 pandemic than those who were food secure. Comparing non-

Hispanic, White students to students of other races and ethnicities, those who were Black, Hispanic, and Asian/Pacific Islander were more likely to be food insecure. In addition, single parents and those living alone were more likely to experience food insecurity.[64]

While the 2020 cross-sectional survey of OHSU students did not show higher rates of food insecurity or relevant associations with sociodemographic factors, the OHSU 2018 survey results showed that students identified as American Indian/Alaska Native, Black, Hispanic, multi-racial, and other races were more likely to be food insecure. Other similarities to the Texas study were that being single was associated with a higher odds of food insecurity while students who were food insecure had a lower mean income percentage provided by full or part-time work.[4] These results suggest that specific sociodemographic variables continue to be identified as risk factors for food insecurity among students, even during the current pandemic, and that addressing modifiable factors could be targets for intervention to decrease food insecurity among university students.

Regardless of food security status, a decrease in university resource use by students after the shelter-at-home mandate was observed suggesting lack of access to campus drastically impacts access to supplemental food. A recent survey of 3,000 college students measured food security status 12 months before and a few weeks after the onset of the COVID-19 pandemic.[70] The study used the US HFSSM 10-item questionnaire twice to determine food security status before and after the onset of the COVID-19 pandemic. If a student's food security score was higher or lower after the onset of the COVID-19 pandemic, they became less food secure or more food secure, respectively. Change of food security status was seen with 22.6% of students becoming less food secure and 15% of students who became more food secure with the onset of the COVID-19 pandemic. Following the onset of the pandemic, 38% of these students

experienced a change in food security status with 59.6% of students becoming less food secure. Reasons suggested for the change in food security status included students remaining on-campus with access to fewer campus food resources, increased unemployment, and ineligibility for federal food assistance programs due to lack of employment.[70] These results indicate that without university resources – both food and non-food – students may experience limited access to direct and indirect sources of supplemental food.

Contrary to expectations, there was not an increase in use of community food resources with the onset of the pandemic. While more students started to use at least one community food resource after the shelter-at-home mandate, there was no significant difference in the number of students using community resources compared to the number of students who used no community resource after the shelter-at-home mandate. With limited data beyond 2-3 months after the shelter-at-home mandate, use of at least one community food resource may have changed more over time. For example, the Coronavirus Aid Relief Economic Security (CARES) Act, and subsequent government economic relief provided direct stimulus payments to individuals with limited income, with additional payments made in 2021. This additional financial support may have helped students who would have been otherwise food insecure, and thus, impacted food security status.[71] Contrary to this hypothesis, as shown by recent survey results, some students who were employed as student workers prior to the pandemic were no longer able to work on-campus during the pandemic. This impacted continued eligibility for federal assistance programs, which limited use of certain community resources.[70] As a result, community food resource use decreased. OHSU provides assistance to students who want to apply for SNAP and other food assistance programs, but students must meet 2021 income guidelines in addition to one of seven other student eligibility guidelines (Appendix G).

There are currently two temporary, expanded edibility criteria that students can use to meet eligibility requirements due to COVID-19 under the Consolidated Appropriations Act, 2021.[72,73] However, despite the expanded eligibility criteria, OHSU students still report that eligibility criteria are difficult to meet. The combined efforts of COVID-19 relief with the reduction in eligibility for food assistance programs due to COVID-19 may contribute to the observed lack of change in community food resource use.

Lastly, difference in patterns of response behaviors and coping strategies were seen among students who were food insecure, with more students reporting food related stress, less motivation to prepare healthy meals, reduced quality of foods purchased, difficulty accessing non-food resources, leaving the home less often due to the pandemic which impacted the amount of food they needed to have on-hand, and being likely to use a future on-campus food pantry. Engaging in coping strategies, such as taking fewer classes, stretching meals, purchasing less expensive food, receiving help from others to obtain food, attending university functions to obtain free food, using food banks/pantries/food assistance programs, selling items or services for food, and eating more when food was plentiful are some of many coping strategies that contribute to higher coping strategy scores among university students.[21,74] These results suggest there are a number of response behaviors and coping strategies students who were food insecure may use to deal with their food insecurity. While the proportion of students who were food insecure did not change among this sample of students during the pandemic, students who are food insecure may engage in behaviors, strategies, and tactics to mitigate the effects of limited food access and availability regardless of the pandemic.

These results provide support for potential interventions OHSU may implement to help students who experience food insecurity. Frequency of use of different university and

community food resources suggests where to deploy university resources such as money, labor, and marketing to reduce food insecurity. Understanding the root causes of response behaviors and coping strategies can help inform interventions to help students. For example, resources may be redirected to help students find affordable transportation and housing knowing that more students who are food insecure report difficulty accessing these non-food related resources. The university may be able to purchase and place refrigerators and microwaves in strategic locations for students to store and reheat food. The university may be able to work with OHSU Food and Nutrition Services to provide less expensive and more convenient food options for students. Lastly, as the Food Resource Center continues to grow to support the entire student base, information students provided regarding foods preferences will help inform food selection and purchasing decisions.

Strengths of this study include the expansion of student-centered, longitudinal food security data that has been collected since 2016 at OHSU. As mentioned before, the current survey data provides baseline information on food security status and sociodemographic data for the new Food Resource Center at OHSU that opened December of 2020. The Food Resource Center receives donated and purchased food from the Oregon Food Bank, local grocery stores, and food retail businesses to provide for food pick-up or delivery to students. Information from the survey will assist the Food Resource Center with purchasing decisions that align with the needs and preferences of students and allow track of changes in food security status over time and in response to various interventions. In addition, the validated US HFSSM was useful in measuring food security status in this study since the tool was repeated twice – once to assess food security status 12 months before and then again 2-3 months after the start of the shelter-at-home mandate. Using the US HFSSM 6-item short form was the most efficient and reliable

validated measurement method to determine change in food security status before and during the pandemic.

The primary limitation of this current study is the sample size. Only 273 students of over 3,000 students enrolled at OHSU completed the survey, and then, after applying exclusion criteria, only 175 students were included in the analysis. This small sample size limited the ability to discern differences in the food security status to 2018 results. The larger sample size of the 2018 survey was achieved in part by providing incentives to students to complete the survey and to dedicating time during classes to respond to the survey.[4] During the 2020 survey, many students likely went to live with family when courses shifted from being delivered in the classroom to virtual, which prevented completion of the survey in class; staying with family likely also impacted food security status by providing an unaccounted for support. In addition, the exact proportion of students who were food insecure (28.5%) in 2018 was not known until after the power analysis for the current study was completed. A post-hoc power analysis determined that a sample size of 500 students was needed to achieve an effect size of 8% to determine differences between food insecurity prevalence measured by the 2018 survey and what was reported among students in Texas after the start of the pandemic.[64]

Another limitation of this study is that a portion of the survey deployment period was completed during the summer when some students were not taking classes and not receiving/opening university-related emails. Different recruitment methods were used in the 2018 survey, which may have led to differences in demographic data, such as gender and program of study compared to the 2020 analysis. Additionally, only a small percentage of student respondents experienced a change in food security status over time, which did not allow the determination of sociodemographic variables that could explain this phenomenon

using a multivariable logistic regression analysis. Comparing proportions of such a small sample size to identify sociodemographic variables that could explain differences in key variables and food security status and university and community food resources use was not possible. Another limitation was the short time period of 2-3 months after the shelter-at-home mandate to determine the impact of the pandemic on food security status. With COVID-19 and its lasting effects still present 15 months later, food insecurity and use of supplemental food resources may have greatly changed from those initial months following the shelter-at-home mandate. Lastly, impact of the new OHSU Food Resource Center was not included in the survey. The OHSU Student Food Resource Center opened during the pandemic in December 2020 to provide supplemental, free food to students. This resource was not assessed for use by students in this survey since it was not available to students until after the survey was disseminated.

Specific recruitment/participation biases may have impacted student patriation and are important to note as they may affect generalizability of these results to the student population currently enrolled at OHSU. First, students who were food insecure may have been more likely to respond to the survey as they may feel this type of survey pertained to their experience with limited access to food. Students may have also been more likely to report being food insecure using the USDA validated food security measurement tool. Conclusions of previous studies found that including the 2-item screener questions before the USDA HFSSM 6-item short form resulted in lower prevalence of food insecurity.[16] Using the 2-item screener questions in this survey may have allowed more students to be included in the analysis (those who were excluded from analysis did not complete one or more of the US HFSSM questions), since those categorized as food secure using these 2 questions would not have been prompted to respond

to the US HFSSM 6-item short form. Lastly, considering physical and mental health outcomes[5,6,22] are associated with food security status, and COVID-19 has had significant impacts on both of these outcomes, completing a survey during this time may have been distressing for students who experienced food insecurity. Students who were food insecure may have also found completing a survey focusing on food security status "triggering", leading to reduced response rates from this group.

Food security is an important goal to reach for students pursuing advanced degrees. Future research must assess food security status as time progresses with the continued effects of COVID-19. This research should determine if current university and community resources are effective at mitigating food insecurity among this high-risk population. Additionally, on-going research should determine how the pandemic has impacted food security status considering its significant economic impact. For example, questions regarding employment status and housing should be included to determine possible relationships to food security status. Another important area of research is to go beyond assessing response behaviors and coping strategies used by students who are food insecure to determine the impact of food insecurity and nutrient consumption on quality of food and overall quality-of-life. Lastly, a larger sample size is needed to identify and confirm risk factors, including sociodemographic variables, seen in 2018 and their association to food security status.

While the overall prevalence of food insecurity was not different before and during the COVID-19 pandemic, food insecurity remains a significant problem among students at OHSU. With limited access to university and community food resources, concerns for obtainable food for students is prominent with many students asking for expanded food access, availability, and infrastructure provided by OHSU. Additionally, many response behaviors and coping strategies

suggest students who were food insecure before and during the pandemic experience reduced quality-of-life. These findings reinforce the need to support students during crisis events, such as the COVID-19 pandemic, to provide expanded food and financial resources to ensure their academic success, health, and wellness.

CHAPTER 6: CONCLUSIONS

Aim 1: Describe the prevalence of food insecurity among the OHSU student population before and during the COVID-19 pandemic between March and June of 2020.

Hypothesis 1a: A significant change in food security status will be seen with more students becoming food insecure, defined using the US HFSSM 6-item short form, after than before the shelter-at-home mandate was enacted in March 2020.

Conclusion 1a: We reject this hypothesis. The proportion of students who were food secure 12 months before and 2-3 months after the COVID-19 pandemic was not significantly different.

Hypothesis 1b: A significant association will exist between change in food security status and sociodemographic variables including age, gender, ethnicity, race, children in the home, marital status, household income, current length in program, tuition waiver, and international student status.

Conclusion 1b: We reject this hypothesis. Sociodemographic variables, including age, gender, ethnicity, race, children in the home, marital status, household income, current length in program, tuition waiver, and international student status were not significantly associated with change in food security status.

Aim 2: Compare the prevalence of food insecurity among OHSU students who responded to the survey administered in the Spring-Fall of 2020 to OHSU students who responded to a similar survey in the Spring of 2018 and to estimates of national food insecurity prevalence.

Hypothesis 2: There will be a significant difference in percentage of OHSU students classified as food insecure by the US HFSSM 6-item short form in 2020 than in 2018 and the current 2019 national household food insecurity prevalence.

Conclusion 2: We reject the hypothesis that the percentage of OHSU students classified as food insecure in 2020 would be significantly higher than in 2018, but we accept our hypothesis that the percentage of food insecure students would be significantly higher than the national food insecurity rate in 2019.

Aim 3: Determine the use of university and community resources that assist with food access by the OHSU student population.

Hypothesis 3a: The percentage of OHSU students who started to use at least one community resources after the shelter-at-home mandate will be significantly higher than the percentage of OHSU students who stopped using any community resource after the shelter-at-home mandate. The percentage of OHSU students who started using at least one university resource after the shelter-at-home will be significantly lower than the percentage of OHSU students who stopped using any university resource after the shelter-at-home mandate.

Conclusion 3a: We reject our hypothesis that the percentage of OHSU students who started to use at least one community resource after the shelter-at-home mandate would be significantly higher than the percentage of OHSU students who stopped using any community resource after the shelter-at-home mandate. However, we accept our hypothesis that the percentage of OHSU students who started using at least one university resource after the shelter-at-home would be significantly lower than the percentage of OHSU students who stopped using any university resource after the shelter-at-home mandate.

Hypothesis 3b: A significant association will exist between change in university or community food resource use and sociodemographic factors including age, gender,

ethnicity, race, children in the home, marital status, household income, current length in program, tuition waiver, and international student status.

Conclusion 3b: We reject our hypothesis that sociodemographic variables would be a significantly associated with change in university and community food resource use. However, a significantly higher proportion of students who were in their program of study for ≥3 years went from using at least one university food resource to no university food resource after the shelter-at-home mandate compared to students who were in their program of study for <3 years.

Aim 4: Determine the types of response behaviors and coping strategies used by students during the COVID-19 pandemic and the association of these response behaviors and coping strategies with food security status after enactment of the shelter-at-home mandate.

Hypothesis 4a: A significant association will exist between response behaviors used during the COVID-19 pandemic and food security status. Students who are food insecure will report higher rates of food-related stress, reduced motivation to cook healthy meals, reduced quality of foods purchased, and more difficulty accessing non-food related resources than their food secure peers.

Conclusion 4a: We accept this hypothesis as there was a significant association between response behaviors and food security status. A higher proportion of students who were food insecure than food secure reported food-related stress, reduced motivation to cook healthy meals, reduced quality of foods purchased, and more difficulty accessing non-food related resources.

Hypothesis 4b: A significant association will exist between coping strategies used during the COVID-19 pandemic and food security status. Students who are food insecure will

report higher rates of spending ≤$50 on groceries per week, leaving the home less often to grocery shop, that leaving the home less often impacts the amount of food needed in their home, purchasing less extra food, more interest in using a future campus food pantry, and preparing food less often.

Conclusion 4b: We accept this hypothesis that there was a significant association between coping strategies and food security status, such as that leaving the home less often impacted the amount of food needed in the home and more interest in using a future campus food pantry. A higher proportion of students who were food insecure than food secure reported that leaving the home less often impacted the amount of food needed in their home and that they were more interest in using a future campus food pantry. However, we reject our hypothesis that there was a significant association between coping strategies such as spending ≤$50 on groceries per week, leaving the home less often to grocery shop, purchasing less extra food, and preparing food less often.

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EVIDENCE TABLE

Citation	Year	Food Insecurity Topic	Population	Methods	Food Security Measurement Tool	Results
Coleman-Jensen, et. al.	2019	Food Security Overview	37,300 US households	Cross-sectional survey from US Census Bureau's annual CPS	US HFSSM 18-item questionnaire	11.1% households classified as food insecure with 6.8% classified as low food secure and 4.3% household classified as very low food secure.
Nikolaus, et. al.	2020	Food Security in Higher-Education Environments	51 journal articles regarding higher-education student food insecurity	Review	65% studies used US HFSSM 10-item or US HFSSM 6-item short form	Food insecurity prevalence estimates were between 10-75%. The weighted food insecurity estimate was 41%. Estimates of food insecurity were larger using the 6-item short form (50%) or 10-item US HFSSM (40%) than the 18-item USFSSM (13%).
Bruening, et. al.	2018	Food Security in Higher-Education Environments	1,138 college freshmen at baseline	Longitudinal assessment	US HFSSM 6-item short form	Lower odds of consuming breakfast and evening meals if food insecure (0.67 99% CI: 0.46, 0.99 and 0.55 99% CI: 0.36, 0.86, $p<0.01$ respectively). Students experiencing food insecurity had lower prevalence of completing moderate to vigorous exercise. Higher odds of perceived stress and depressed mood if food insecure (1.69 99% CI: 1.16,2.46 and 1.98 99% CI: 1.34, 2.91, $p<0.01$, respectively).

DeMunter, et. al.	2020	Oregon Health & Science University and Student Food Security	1,133 health profession students from OHSU	Cross-sectional survey	US HFSSM 6-item short form	25% of students classified as food insecure. Students with food insecurity had higher odds (11.7 95% CI: 8.33, 16.55) of reporting food insecurity affecting academic performance. Student food discounts, a food recovery app, and a resource list were the top campus resources students reported to be somewhat or very helpful.
El Zein, et. al.	2019	Food Security in Higher-Education Environments	855 first-year undergraduate students from 8 US universities	Longitudinal assessment	US HFSSM 10-item questionnaire	Higher perceived stress score among food insecure than food secure students (30.2 ± 5.7 vs. 26.7 ± 5.8, $p<0.0001$). Higher percentage of students who were food insecure with poor sleep quality than food secure students (80.3% vs. 61.1%, $p<0.0001$). 8.2% students experiencing food insecurity had GPA of 2.50-2.59 compared to 4.4% food secure students.
Martinez, et. al.	2019	Food Security in Higher-Education Environments	8,932 undergraduate and graduate students from 10 Universities of California campuses	Cross-sectional survey	US HFSSM 6-item short form	Food insecurity was associated with fewer days of enough sleep (beta=0.21, $p<0.001$), fewer days of physical activity (beta=0.03, $p=0.03$), reduced daily fruit/vegetable intake (beta=0.16, $p<0.001$), and poor health (beta=0.11, $p<0.001$). Students who were food insecure had a higher average BMI compared to food secure students.

Gaines, et. al.	2014	Food Security in Higher-Education Environments	557 university students, excluding freshman and graduate level	Cross-sectional survey	US HFSSM 10-item questionnaire	Higher mean number of financially independent students who were food insecure (23 ± 15.43) compared to food secure students (21 ± 34.43), p<0.001. Higher mean number food secure students with family financial support (306 ± 68.64) compared to food secure students (47 ± 10.51), p<0.001.
El Zein, et. al.	2018	Food Security in Higher-Education Environments	899 undergraduate and graduate students	Cross-sectional survey	US HFSSM 10-item questionnaire	15.6% of students used the food pantry. 36.4% using the food pantry used it as a primary source of food. Food insecurity was associated with reporting barriers to accessing food pantry (p<0.001).
Raskind, et. al.	2019	Food Security in Higher-Education Environments	2,377 students from seven Georgia colleges and universities	Longitudinal study	US HFSSM 6-item short form	29% of students were food insecure. Food insecurity was associated with a 1.83-point increase in depression scores (SE=0.25, p<0.0001), 3.68-point increase in anxiety scores (SE=0.69, p<0.001), 2.16-point decrease in hope score (SE=0.36, p<0.0001).
Nikolaus, et. al.	2019	Food Security Overview	462 students from a midwestern university	Cross-sectional survey	US HFSSM 10-item questionnaire with 2-item screener questions. US HFSSM 6-item short form estimated from US HFSSM 10-item questionnaire	Difficulty answering question regarding "balanced meals." Addition of 2-item screener to 6-item short form or 10-item US HFSSM reduced prevalence of food insecurity compared to 6-item short form or 10-item US HFSSM alone.

Marques, et. al.	2015	Food Security Overview	35 journal articles regarding use of measurement tools to assess food insecurity	Review	N/A	The US HFSSM 18-item questionnaire (known as the Core Module Security/Household Food Security Survey Module), Self-Perceived Household Food Security Scale and US HFSSM 6-item short form (HDSSM-6SF) were most used among students. Internal consistency of the US HFSSM 18-item questionnaire was α =0.73-0.95.
Blumberg, et. al.	1999	Food Security Overview	44,647 households assessed by the US Census Bureau	Cross-sectional survey	US HFSSM 6-item short form	US HFSSM questionnaire with items 2, 3, 5, 7, 8, 10 from the original 18-item questionnaire. Survey correctly identified food security for 97.1% households with 92% sensitivity and 99.4% specificity. Less sensitive and specific for households with children.
Nikolaus, et. al.	2019	Food Security Overview	33 undergraduate students ages 18-24 years-old	Cross-sectional survey	U HFSSM 10-item questionnaire	Interpretation of questions was difficult based on time frame of the question and resources available. Lack of clarity about "balanced meals," "weight loss," and "money." Challenges with answering questions were attributed to lifestyle, family support, financial assistance, meal plans, and other factors.

Leung, et. al.	2014	Food Security Overview	8,129 NHANES participants, age 20-65 years old, poverty </= 300% federal poverty line	Cross-sectional survey	US HFSSM 18-item questionnaire	Food insecure (low and very low) participants had 8% higher intake of high-fat dairy, 4% higher intake of salty snacks, 8-12% higher intake of sugar-sweetened beverages, 6-12% lower intake of vegetables, 2-5% higher intake of red/processed meat, and 3% lower HEI-2005 score compared to food secure participants.
Spees, et. al.	2017	Food Security Overview	4,789 NHANES adult participant	Cross-sectional survey	US HFSSM 18-item questionnaire	Higher odds of receiving food from convenience store if very low food secure (1.5 95% CI: 1.07, 2.10). Food insecure participants had 9.4% higher mean total energy intake.
Davison, et. al.	2017	Food Security Overview	20,498 participants from Canadian Community Health Survey ages 19-70 years old	Cross-sectional survey	US HFSSM 18-item questionnaire	Higher odds of food insecurity if having poor mental health (1.60 95% CI: 1.45, 1.75, p=0.0048) and lower overall intake of vitamin A, thiamin, riboflavin, niacin, pyridoxine, vitamin C, iron, magnesium, phosphorus, and zinc regardless of mental health status.
Gowda, et. al.	2012	Food Security Overview	12,9191 NHANES participants >18 years of age	Cross-sectional survey	US HFSSM 18-item questionnaire	Marginal food insecurity had higher odds of BMI >30 kg/m^2 (1.33 95% CI: 1.05, 1.69). High food insecurity had higher odds of BMI <18.5 kg/m^2 (1.74 95% CI: 1.02, 2.96). Higher odds of high C-reactive protein with high food insecurity (1.21 95% CI: 1.04, 1.40) and high white blood cell count >10,000 cells/uL (2.45 95% CI: 2.17, 2.77).

Pan, et. al.	2012	Food Security Overview	75,103 adults from 12 states	Cross-sectional survey	US HFSSM 18-item questionnaire	Higher prevalence of obesity (BMI ≥30kg/m^2) in food insecure adults (35.1%) compared to food secure adults (25.2%), p<0.0001.
Tait, et. al.	2018	Food Security Overview	4,739 Ontario adults >18 years old from Canadian Community Health Survey	Cross-sectional survey	US HFSSM 18-item questionnaire	Higher prevalence of obesity (BMI ≥30 kg/m^2) in food insecure adults (27.4%) compared to food secure adults (18.8%). Higher prevalence of smoking if food insecure (50.2%) compared to food secure (21.4%), p<0.0001. Higher prevalence of heavy drinking if food insecure (15.3%) compared to food secure (4.7%), p<0.0001).
Seligman, et. al.	2010	Food Security Overview	5,094 NHANES participants, age 18-65 years old, poverty </= 200% national poverty level	Cross-sectional survey	US HFSSM 18-item questionnaire (only used 10-items that addressed adult food security status)	Higher prevalence of clinically diagnosed hypertension in food insecure adults (22.4%) compared to food secure adults (18.6%). Higher prevalence of clinically diagnosed hyperlipidemia in food insecure adults (21.7%) compared to food secure adults (19.8%). Higher prevalence of clinically diagnosed diabetes in food insecure adults (10.2%) compared to food secure adults (7.4%).
Charkhchi, et. al.	2018	Food Security Overview	84,353 participants 18 years or older from Behavioral Risk Factor Surveillance System	Cross-sectional survey	1-item question (not specific to US HFSSM)	Higher odds of food insecurity with the following chronic conditions: cancer (1.39 95% CI: 1.02, 1.91), cardiovascular disease (1.75 95% CI: 1.12, 2.73), lung disease (1.78 95% CI: 1.20, 2.63).

Murillo, et. al.	2017	Food Security Overview	19,048 participants from National Health Interview Survey 18-59 years old	Cross-sectional survey	US HFSSM 10-item questionnaire	Higher odds of women with pre-diabetes if food insecure (1.62 95% CI: 1.22, 2.16).
Silverman, et. al.	2015	Food Security Overview	287 participants age 30-70 years with poorly controlled Type II Diabetes, <250% federal poverty level	Cross-sectional survey	US HFSSM 6-item short form	Higher percentage experiencing hypoglycemia among food insecure adults (57.7%) compared to food secure adults (45.2%), p=0.04. Food insecure adults have lower mean mental health scores (44.6) compared to food secure adults (48.9), p=0.003. Food insecurity associated with odds of being depressed, having diabetes distress, and lower medication adherence.
Gundersen, et. al.	2018	Food Security Overview	90,368 adults >18 years old from Canadian Community Health Survey	Cross-sectional survey	18 question module (not specified)	Higher odds of mortality for moderate food insecurity (1.51, 95% CI: 1.23, 1.85) and severe food insecurity (2.03, 95% CI: 1.55, 2.65)
Stuff, et. al.	2004	Food Security Overview	1,488 participants representing 1 household from Lower Mississippi Delta Study, >18 years old	Cross-sectional survey	US HFSSM 18-item questionnaire	Lower mean physical and mental health scores among food insecure adults (45.7 ± 0.8 and 46.5 ± 0.8, respectively) compared to food secure adults (50 ± 0.3 and 53.4 ± 0.2, respectively).

Hagedorn, et. al.	2018	Food Security in Higher-Education Environments	692 undergraduate students	Cross-sectional survey	US HFSSM 10-item questionnaire	Higher mean scores for money expenditure scale (12.33 $\pm$ 0.14 compared to food secure students (10.58 $\pm$ 0.06), p<0.0001. Higher percentage of students who were food insecure reporting fair (23.3%) and poor (3%) health status compared to food secure students (8% and 0.5%, respectively), p<0.0001. Lower mean academic success scores among students who were food insecure (12.39 ± 0.13) compared to food secure students (13.28 $\pm$ 0.09), p<0.0001.
Soldavini, et. al.	2020	Food Security in Higher-Education Environments	4,829 college students	Cross-sectional survey	US HFSSM 10-item questionnaire	Higher odds of being food insecure if male (1.27 95% CI: 1.08, 1.51), African American (2.59 95% CI: 1.95, 3.43), having dependent children (2.65 95% CI [1.68, 4.18]), having one or more part-time jobs (1.48 95% CI: 1.26, 1.75), receiving financial aid (1.65 95% CI: 1.40, 1.95), and having lower perceived health.

McArthur, et. al.	2018	Food Security in Higher-Education Environments & Coping Strategies of Individuals Experiencing Food Insecurity	1,093 sophomores to graduate level students	Cross-sectional survey	US HFSSM 10-item questionnaire	90% of students reported that they could use more sources of support for accessing food on campus. Higher percentage of students who were food insecure (27%) rated health as fair or poor compared to food secure students (8.5%), p<0.001. Higher percentage of overweight/obese students who were food insecure (38%) compared to food secure students (30.6%), p=0.01. Higher percentage of food secure students consumed vegetables and vegetable juices (71.1%) compared to students who were food insecure (56.1%). Positive correlation between CSS scores and US HFSSM (r=0.42, p<0.001).
Payne-Sturges, et. al.	2018	Food Security in Higher-Education Environments	237 undergraduate students	Cross-sectional survey	US HFSSM 18-item questionnaire	Higher percentage of students who were food insecure receiving financial aid (91%) vs. food secure (64%), p=0.014. More hours of sleep per day for food secure students (p=0.0085). Higher percentage of students who were food insecure reported depressive symptoms. Higher percentage of students who were food insecure reported suboptimal health (17%) compared to food secure students (7%), p<0.001.

Patton-López, et. al.	2014	Food Security in Higher-Education Environments	354 undergraduate students	Cross-sectional survey	US HFSSM 6-item short form	Food insecurity associated with higher odds of participation in federal assistance programs (1.91 CI 95% [1.05-3.45], p=0.03), higher odds of income <$15,000 (2.23 CI 95% [1.07-4.63], p=0.03), higher odds of fair/poor health status (2.08 CI 95% [1.09-3.95], p=0.03)
Morris, et. al.	2016	Food Security in Higher-Education Environments	1,882 undergraduate students from 4 universities	Cross-sectional survey	US HFSSM 10-item questionnaire	More students with grade point average of 3.00-3.99 were classified as high food secure (566 $\pm$ 2.4) than students classified as very low food secure (197 $\pm$ -1.9).
Farahbakhsh, et. al.	2015	Food Security in Higher-Education Environments	58 higher-education students	Cross-sectional survey	US HFSSM 10-item questionnaire	Common coping strategies: using friends (39.7%), financial aid (27.6%), use of a food bank (31%), money from friends or family (19.0%). About 83% students liked the campus food pantry food. About 30% students did not know how to prepare some food pantry items.
Ahluwalia, et. al.	1998	Coping Strategies of Individuals Experiencing Food Insecurity	141 participants samples from low-income services	Focus Groups	8-item Community Childhood Hunger Identification Project hunger Scale	Eighty-two percent of participants used federal or private program (Food Stamps, food bank, ect.). Individual coping strategies: low-cost food, store-brand food, shopping at multiple stores, coupons, budgeting, sales, bulk foods, shopping with others to reduce transport cost, eating less, staggering bills, faith. Social coping strategies: groceries, meals, money to buy food from family, emotional aid.

De Marco, et. al.	2009	Coping Strategies of Individuals Experiencing Food Insecurity	38 Oregon participants who were low income and/or food insecure	Cross-sectional survey	US HFSSM 10-item questionnaire	Coping strategies: food nutrition assistance programs (Food Stamps, WIC, School Breakfast/Lunch program, soup kitchens, food pantries), unique ways to pay bills, social support, food "stretching."
Stebleton, et. al.	2020	Coping Strategies of Individuals Experiencing Food Insecurity	23 food insecure higher-education students	Qualitative Interviews	US HFSSM 6-item short form	Coping strategies: snacking, skipping meals, borrowing friends' meal swipes, going to bed early, ignoring hunger signs. Mental health and anxiety: senses of hopelessness, worry about finances, reduced focus in class and academics, feelings of social isolation.
Hanbazaza, et. al.	2017	Coping Strategies of Individuals Experiencing Food Insecurity	51 students using on-campus food bank	Cross-sectional survey, convenience sample	US HFSSM 10-item questionnaire	Top coping strategies of international students: seeking employment (85.2%), purchasing food using a credit card (70.4%), delaying purchasing university supplies or not buying (74.1%), applying for a loan or bursary (70.4%). Top coping strategies for domestic students: applying for a loan or bursary (90.3%), purchasing food using a credit card (83.9%), seeking employment (80.6%).

Clay, et. al.	2018	Food Security in Crisis Events	737 participants from Gulf Coast Child and Family Health Study	Cross-sectional survey	1-item question based on US HFSSM	Higher prevalence and strong positive relationship of post-traumatic stress disorder in food insecure participants (18.1%) compared to food secure participants (6%), p<0.001. Higher prevalence and strong positive relationship of disability in food insecure participants (33.1%) compared to food secure participants (16.6%), p<0.001. Higher prevalence and strong positive relationship of physical health distress in food insecure participants (68.1%) compared to food secure participants (47.8%), p<0.001.
Clay, et. al.	2020	Food Security in Crisis Events	1,002 households affected by Hurricane Harvey	Cross-sectional survey	2-item validated food security screener (not specified)	Higher odds of food insecurity with job loss (2.43 95% CI: 1.73, 3.41, p<0.05) and lower odds of social support if food insecure (0.37 95% CI: 0.25, 0.55, p<0.05)
Birkenmaier, et. al.	2016	Food Security in Crisis Events	14,417 households age 16-60 years old	Cross-sectional survey	US HFSSM 18-item questionnaire	About 18% participants were unemployed and 27.9% were unemployed and low-income with 78% higher odds of being food insecure for those unemployed. One more week of unemployment raised odds of food insecurity by 1% (p<0.01).

Huang, et. al.	2016	Food Security in Crisis Events	First sample: 15,856 participants age 16-60 who were employed, second sample: 13,847 participants age 16-60 who were employed	Cross-sectional survey	US HFSSM 18-item questionnaire	Lower mean number social support score for food insecure homes (4.4 $\pm$ 2.3 compared to food secure homes (5.4 $\pm$ 2.5). One or more times experiencing unemployment increased odds of food security (1.20 CI 95% [1.12,1.28], p<0.001). One extra week of unemployment increased odds of food insecurity (1.01 95% CI: 1.01, 1.02, p<0.001). Higher odds of food insecurity if ever experiencing unemployment (1.54 95% CI: 1.27, 1.88, P<0.001).
Marin, et. al.	2016	Food Security in Crisis Events	85,674 participants 12 years and older from Canadian Community Health Survey	Cross-sectional survey	US HFSSM 10-item questionnaire	Higher rates of very weak community belonging if severely food insecure (22.8%) compared to food secure (8.8%). Higher rates of being very stressed if food insecure (16.5%) compared to food secure (3.2%).

APPENDIX

Appendix A-1: Food Security Status Breakdowns

Table 1: USDA Food Security Status Classifications[19,20]

Label	Definition
Food Secure	
High food security	Households had no problems, or anxiety about, consistently accessing adequate food.
Marginal food security	Households had problems at times, or anxiety about, accessing adequate food, but the quality, variety, and quantity of their food intake were not substantially reduced.
Food Insecure	
Low food security	Households reduced the quality, variety, and desirability of their diets, but the quantity of food intake and normal eating patterns were not substantially disrupted.
Very low food security	At times during the year, eating patterns of one or more household members were disrupted and food intake reduced because the household lacked money and other resources for food.

Definitions of food security status labels are taken directly from the United States Department

(USDA) of Agriculture.

Appendix A-2: US HFSSM Questions and Scoring

Table 2: US HFSSM 6-Item Short Form and COVID-19 Questions[63]

US HFSSM Item	Question	Response Options	Affirmative Answer
US HFSSM 6-item short form			
HH3	The food that (I/we) bought just didn't last, and (I/we) didn't have money to get more	Often true, sometimes true, never true, do not know or refused	Often, sometimes
HH4	(I/we) couldn't afford to eat balanced meals	Often true, sometimes true, never true, do not know or refused	Often, sometimes
AD1	In the last 12 months, since last (name of month, did (you/you or other adults in your household) ever cut the size of your meals or skip meals because there wasn't enough money for food?	Yes, no, do not know	Yes
AD1a	[If yes from above] How often did this happen?	Almost every month, some months but not every month, only 1 or 2 months, do not know	Almost every month, Some months but not every month
AD2	In the last 12 months, did you ever eat less than you felt you should because there wasn't enough money for food?	Yes, no, do not know	Yes
AD3	In the last 12 months, were you ever hungry but didn't eat because there wasn't enough money for food?	Yes, no, do not know	Yes

Table 2: US HFSSM 6-Item Short Form and COVID-19 Questions[63]

US HFSSM Item	Question	Response Options	Affirmative Answer
Question 1	I am worried about our food running out before getting money to buy more	Often true, sometimes true, never true, do not know or refused	Often, Sometimes
Question 2	The food we buy just doesn't last and we don't have money to get more.	Often true, sometimes true, never true, do not know or refused	Often, Sometimes

US HFSSM Items are labeled as the question taken from the original 18-item questionnaire. HH3 = Household Question 3, Household Question 4, AD1 = Adult Question 1, AD1a = Adult Question 1a, AD2 = Adult Question 2, AD3 = Adult Question 3. Household Questions measure household level food insecurity and Adult Questions measure adult level food insecurity. COVID-19 2-item screener questions provided by Diane Stadler, PhD, RD, LD, email communication, May 18th, 2020.

Appendix A-3: Scoring of the US HFSSM 6-Item Short Form

Table 3: US HFSSM 6-Item Short Form Raw Score and Food Security Status[63]

Raw Score	Food Security Status Classification
0-1	High or marginal food security
2-4	Low food security
4-6	Very low food security
Dichotomization of Food Security Status Classification	
0-1	Food Secure
2-6	Food Insecure

Appendix B: OHSU Intranet Posting

OHSU Now story – to be posted on the internal OHSU Now site and accessible by students and faculty/staff who have opted into the Student Essentials category

Heading: Help OHSU better understand how to enhance food security among students– share your opinions and tell us about your experience in this anonymous survey

The health of our students is very important to OHSU, and especially so in the time of this global pandemic. We are conducting an important study to better understand the extent to which our students have sufficient access to adequate food for themselves and their families during the time of COVID-19, and we want to hear from you.

This survey is accessible online <insert to survey link> and will take approximately 10 to 15 minutes to complete. Your input will help OHSU gather information to identify strategies for addressing the problem of food insecurity.

Your participation is voluntary, and all surveys will be anonymous and not linked to any identifier. At the end of the study, your survey responses will be stored in a repository for future research purposes. For more information, please see the attached Information Sheet.

This survey was developed by Corrin Kalinich, master's student in the Graduate Programs in Human Nutrition, working closely with Jodi DeMunter, Medical Director of OHSU's Student Health Center.

Appendix C: Recruitment Message

Subject Line: Invitation to take part in an important OHSU student survey…

Dear Students:
My name is Corrin Kalinich and I am a master's student in the Graduate Programs in Human Nutrition. I am working with Jodi DeMunter, Medical Director of OHSU's Student Health Center and principal investigator of the 2018 study "Where Do Graduate Students Fit into the Grocery Gap? Assessing Food Availability in an Urban Academic Setting and Potential Impact Strategies." The health of our students is very important, and in this regard, we are conducting this important study to better understand the extent to which OHSU students have sufficient access to adequate food for themselves and their families during the COVID-19 pandemic.

This survey will also help gather information to help OHSU identify potential strategies for addressing the problem where it exists. This online survey will take approximately 10 to 15 minutes to complete.

Your participation is voluntary, and your answers will not be linked to your name. All surveys will be anonymous and not linked to any identifier. At the end of the study, your survey responses will be stored in a repository for future research purposes. Please see the attached Information Sheet for more information.

Your link to the survey is provided below.
[insert link to survey]

Thank you very much for your time and consideration!!

Very sincerely,
Corrin Kalinich and Jodi DeMunter, MD
eIRB 17281

Appendix D: Survey Questions

Food Insecurity Survey

The purpose of this survey is to learn more about you and any experiences you have had regarding food insecurity while being a student at OHSU/PSU. The survey has 45 questions divided into four sections and takes less than 10-15 minutes of your time. ***We greatly appreciate your participation!!!***

Section 1: Demographics:

Instructions: These first questions will help us describe who completed this survey. Please choose the response that best characterizes you or your current situation.

1. What is your current age in years? _____ Years

2. Gender: 1. Male 2. Female 3. Transgender 4. Non-binary _____

3. Which program of study are you currently in?

1. Medical School (including M.D., combined M.D./Ph.D. or combined M.D./M.P.H)
2. Graduate Medicine Programs (Certificates, M.S. or Ph.D. Graduate Programs)
3. Physician Assistant
4. Human Nutrition (including DI Certificate and M.S.)
5. Undergraduate Health Profession Programs (Radiation Therapy, Emergency Medical Tech/Paramedics, Laboratory Services Programs)
6. School of Dentistry
7. School of Nursing (including Undergraduate and Graduate Programs)
8. College of Pharmacy
9. School of Public Health

4. How many years have you been in your current program of study?

1. < 1 year
2. 1-2 years
3. 3-4 years
4. ≥ 5years

4. Approximately how many years do you have left in your program?

1. < 1 year
2. 1-2 years
3. 3-4 years
4. ≥ 5years

5. Are you an International Student? 1. Yes 2. No

6. What is your race?
    1. American Indian/Native Alaskan
    2. Asian or Pacific Islander
    3. Black
    4. Native Hawaiian
    5. Multi-race: Please describe: _____
    6. White
    5. Other: Please describe:_____

7. What is your ethnicity? 1. Hispanic 2. Non-Hispanic

8. What is your marital status?
    1. Single
    2. Married/Partnered
    3. Separated
    4. Divorced
    5. Widowed

9. Do you have children? 1. Yes 2. No

10. What was your annual pre-tax household income last year?
    1. <$12,000
    2. $12,001-25,000
    3. $25,001-$50,000
    3. $50,001-$100,000
    4. >$100,000
    5. Don't know
    6. Prefer to describe: _____

11. How many people living in your household, including yourself, depend on your household income for living expenses, such as housing and food? _____

12. Please estimate the breakdown of your sources of income over the past year (*total must equal 100%, "0" can be a response*).

Income Source	**% of Your Income**
Full or part time job	%
Scholarship	%
Savings	%
Family support	%
Government Loans	%
Private Loans	%
Public Assistance	%
Stipend from OHSU	%

Other - Describe:	%
Other - Describe:	%
Total must equal 100%)	**100%**

13. Did you receive a tuition waiver from OHSU this past year? 1. Yes 2. No

Section 2: Food Insecurity Questions:[1,2]

*Instructions: These next questions ask about shopping for food and the food eaten by you and those who are **dependent** on you for food in your household, such as family members or roommates. When we refer to the **shelter-at-home mandate,** we are referring to the response to the COVID-19 virus to promote the CDC's recommendations for social distancing.[3] We will be asking you about two time periods, the 12 months prior to the shelter-at-home mandate, and the 2-3 months since the shelter-at-home mandate started. Please indicate the response that best fits your situation:*

14. **In the 12 months prior to the shelter-at-home mandate**, how much on average does your household spend on groceries each week?

1. <$20
2. $21-50
3. $51-100
4. $101-150
5. $151-200
6. >$200

	Never True	Sometimes True	Often True	Don't Know	Prefer Not to Answer
15. **In the last 12 months prior to the shelter-at-home mandate**, the food that I/we bought just didn't last, and I/we didn't have money to get more.	**1**	**2**	**3**	**4**	**5**
16. **In the last 12 months prior to the shelter-at-home mandate**, I/we couldn't afford to eat balanced meals.	**1**	**2**	**3**	**4**	**5**

[1] US Department of Agriculture's (USDA) 6 item Food Security Survey Module (FSSM)- also used by the Wisconsin HOPE lab for their national study. We would change them into a written survey format. https://www.ers.usda.gov/media/8282/short2012.pdf

[2] Survey Scoring: Raw score 0-1—High or marginal food security (raw score 1 may be considered marginal food security, but a large proportion of households that would be measured as having marginal food security using the household or adult scale will have raw score zero on the six-item scale)
Raw score 2-4—Low food security
Raw score 5-6—Very low food security

[3] The Center for Disease Control and Prevention defines social distancing as staying 6 feet apart from individuals and staying away from large groups or gatherings. The shelter-at-home mandate is in response to COVID-19 to promote remaining at home to prevent the spread of the virus.

18. **In the last 12 months <u>prior to the shelter-at-home mandate</u>**, did you or other adults in your household ever need to cut the size of your meals or skip meals because there wasn't enough money for food or you needed to allocate available funds away from your food budget?

1. Yes 2. No 3. Don't Know 4. Prefer Not to Answer

18a**. If Yes**, how often did this happen?

Only 1 or 2 Months	Some Months but Not Every Month	Every Month or Almost Every Month	Don't Know	Prefer Not to Answer
1	**2**	**3**	**4**	**5**

19. **In the last 12 months <u>prior to the shelter-at-home mandate</u>**, did you ever eat less than you felt you should because there wasn't enough money for food?

1. Yes 2. No 3. Don't Know 4. Prefer Not to Answer

20. **In the last 12 months <u>prior to the shelter-at-home mandate</u>**, were you ever hungry but didn't eat because there wasn't enough money for food?

1. Yes 2. No 3. Don't Know 4. Prefer Not to Answer

21. **In the past 2-3 months <u>since the shelter-at-home mandate started</u>,** how much on average does your household spend on groceries each week?

1. <$20
2. $21-50
3. $51-100
4. $101-150
5. $151-200
6. >$200

	Never True	Sometimes True	Often True	Don't Know	Prefer Not to Answer
22. **In the past 2-3 months <u>since the shelter-at-home mandate started</u>**, the food that I/we bought just didn't last, and I/we didn't have money to get more.	**1**	**2**	**3**	**4**	**5**
23**. In the past 2-3 <u>months since the shelter-at-home mandate started</u>**, I/we couldn't afford to eat balanced meals.	**1**	**2**	**3**	**4**	**5**

24. **In the past 2-3 months <u>since the shelter-at-home mandate started</u>,** did you or other adults in your household ever need to cut the size of your meals or skip meals because there wasn't enough money for food or you needed to allocate available funds away from your food budget?

1. Yes 2. No 3. Do not know 4. Prefer not to answer

24a. **If yes,** how often?

Only 1 or 2 Months	Some Months but Not Every Month	Every Month or Almost Every Month	Don't Know	Prefer Not to Answer
1	**2**	**3**	**4**	**5**

25. **In the past 2-3 months <u>since the shelter-at-home mandate started</u>,** did you ever eat less than you felt you should because there wasn't enough money for food?

1. Yes 2. No 3. Do not know 4. Prefer not to answer

26. **In the past 2-3 months <u>since the shelter-at-home mandate started</u>**, were you ever hungry but didn't eat because there wasn't enough money for food?

1. Yes 2. No 3. Do not know 4. Prefer not to answer

27. Please rank the top three things that have affected your food budget **in the past 2-3 months**:

Top 3 things that affect your food budget	Rank
Housing Costs	
Childcare Costs	
Costs related to my educational program	

Transportation Costs	
Electronic Support Costs (i.e wifi, computer, printer)	
Being Unemployed	
Other - Please describe:	

28. How often do you think lack of food might be affecting your academic performance at OHSU **in the past 2-3 months**?

Never	Every Few Months	About Every Month	About Every Week	About Every Day	Don't Know	Prefer Not to Answer
1	2	3	4	5	6	7

Section 3: OHSU Specific Questions

Instructions: These next questions ask about food resources you may use on and off-campus. Please indicate the response that best fits your situation:

29. What is your primary campus location?

1. Portland
2. Ashland
3. Klamath Falls
4. La Grande
5. Corvallis
6. Monmouth
7. Distance Learning

30. **Before** the shelter-at-home mandate was initiated in response to the COVID-19 virus, did you use any of the following OHSU campus resources to help with accessing food? Please select all that apply.

1. On-campus food vendor student discounts
2. Food Resource Guide
3. Student Health Meal-in-a-bag program
4. On-campus free meals/snacks provided by seminars, presentation, and/or meetings

5. Did not use any campus resources
6. Other: Please describe _____

31. **After** the shelter-at-home mandate was initiated in response to the COVID-19 virus, did you use any of the following OHSU campus resources to help with accessing food? Please select all that apply.

1. On-campus food vendor student discount
2. Food Resource Guide
3. Student Health Meal-in-a-bag program
4. On-campus free meals/snacks provided by seminars, presentation, and/or meetings
5. Do not use any campus resources
6. Other: Please describe_____

32. **Before** the shelter-at-home mandate was initiated in response to the COVID-19 virus, did you use any of the following off-campus resources to help with accessing food? Please select all that apply.

1. Supplemental Nutrition Assistance Program (SNAP)
2. Women, Infants, and Children (WIC)
3. Temporary Assistance for Needy Families (TANF)
4. Oregon Food Bank (including food pantries, Child Hunger Program, and free food markets)
5. Portland State University Harvest Share
6. Unemployment insurance
7. Did not use any off-campus resources
8. Other: Please describe _____

33. **After** the shelter-at-home mandate was initiated in response to the COVID-19 virus, did you use any of the following off-campus resources to help with accessing food? Please select all that apply.

1. Supplemental Nutrition Assistance Program (SNAP)
2. Women, Infants, and Children (WIC)
3. Temporary Assistance for Needy Families (TANF)
4. Oregon Food Bank (including food pantries, Child Hunger Program, and free food markets)
5. Portland State University Harvest Share
6. Unemployment insurance
7. Do not use any off-campus resources

8. Other: Please describe _____

34. **Before** the shelter-at-home mandate was initiated in response to the COVID-19 virus, how frequently did you use on-campus vending machines?

1. Never or less than one time per month
2. 1-3 times per month
3. Once a week
4. 2-4 times a week
5. 5-6 times a week
6. Once a day
7. 2-3 times a day
8. >4 times a day

34a. If you did use a vending machine on-campus, was/were the food item(s) you purchased affordable or expensive?

Very Affordable	Slightly Affordable	Neutral	Slightly Expensive	Very Expensive
1	**2**	**3**	**4**	**5**

34b. If you did use a vending machines on-campus, did the food item(s) you purchased satisfy your feeling of hunger?

1. Yes 2. No 3. Do not know 4. Prefer not to answer

35. If you were to receive assistance whether now during this COVID-19 time or in the future, for you and your loved ones, what items would you prefer? Feel free to give specifics in the comments area.

1. fresh fruit and vegetables
2. frozen or canned fruit and vegetables
3. pre-packaged meals for work or home
4. vegetarian proteins
5. animal proteins
6. dry goods - grains, beans or flour
7. nuts or nut butters
8. milk or dairy products
9. non-diary milk alternative
10. breads
11. baked goods- sweet treats
12. gluten-free pastas, breads, baked goods
13. body products

14. Comment- other products?

36. If you had access to a food pantry at OHSU year-round, how likely would you be to use it?

Extremely likely	Somewhat likely	Neither likely nor somewhat unlikely	Somewhat unlikely	Extremely unlikely
1	**2**	**3**	**4**	**5**

36a. If you were to pick up groceries either from a pantry or the farmers market, what time would you ideally like to get these?

1. 6am-7am
2. 7am - 9am
3. 9am -11am
4. 11am - 1pm
5. 1pm - 3pm
6. 3pm - 5pm
7. 5pm - 7pm
8. 7pm - 9pm

Section 4. COVID-19 Specific Questions

Instructions: This next section asks how the current COVID-19 pandemic has affected access to food, mental health, and daily living.

37. How often have you felt stressed because of financial worry related to eating or feeding your family in the **past 2-3 months?**

Never	Every Few Months	About Every Month	About Every Week	About Every Day	Don't Know	Prefer Not to Answer
1	**2**	**3**	**4**	**5**	**6**	**7**

38. Are you preparing food for yourself and/or your family more or less often than in the **past 2-3 months?**

Significantly Less often	Slightly Less often	Not changed	Slightly More often	Significantly More often
1	**2**	**3**	**4**	**5**

39. Is COVID-19 related stress affecting your motivation to cook healthy food?

Significantly Less Motivated	Slightly Less Motivated	Not changed	Slightly More motivated	Significantly More Motivated
1	**2**	**3**	**4**	**5**

40. **In the past 2-3 months**, have you been leaving the home less often to obtain food because of **fear** of possible exposure or contamination of your food? (This includes grocery shopping or using other resources such as the Food Bank, food pantries, or free food markets.)

    1. Yes 2. No 3. Do not know 4. Prefer not to answer

    40a. **If yes**, does this impact the amount of food you need to feed yourself and/or your family?

    2. Yes 2. No 3. Do not know 4. Prefer not to answer

41. **In the past 2-3 months**, have you been purchasing extra food in case you are unable to shop when you run out of food? (i.e. to reduce exposure to the virus and/or you or a family member is sick)

    1. Yes 2. No 3. Do not know 4. Prefer not to answer

42. **In the past 2-3 months**, how do you think the quality of your food options/products have changed?

Significantly Improved	Slightly Improved	Not changed	Slightly Declined	Significantly Declined
1	**2**	**3**	**4**	**5**

43. **In the past 2-3 months**, have you had difficulty accessing the following resources? Please select all that apply.

    a. Affordable housing (including rent, utilities, and mortgages)
    b. Affordable and available childcare
    c. Transportation (including personal and public transit)
    d. Health care
    e. Other: Please describe _____

44. Which of the following resources to help with accessing food would you use if available to you through OHSU? Please select all that apply.

a. On-campus food pantry
b. SNAP support to help determine eligibility
c. Cooking classes
d. Access to additional food storage on-campus
e. On-campus food preparation facilities (i.e. microwaves, toasters, stove tops)

45. Is there any additional information that you would like us to know about your ability to access food or recommendations that you have for OHSU to improve your access to food?

_____

Thank you for completing this survey!!

Appendix E: Specific Aims, Hypotheses, and Statistical Analysis

Table 4: Statistical Analysis Summary

Specific Aim	Hypothesis	Statistical Test
Specific Aim 1: Describe the prevalence of food insecurity among the OHSU student population before and during the COVID-19 pandemic between March and June of 2020.	**Hypothesis 1a:** A significant change in food security status will be seen with more students becoming food insecure, defined using the US HFSSM 6-item short form, after than before the shelter-at-home mandate was enacted in March 2020.	McNemar's test to determine change in food security status and before and after the shelter-at-home method ($p< 0.05$).
	Hypothesis 1b: A significant association will exist between change in food security status and sociodemographic factors including age, gender, ethnicity, race, children in the home, marital status, household income, current length in program, tuition waiver, and international student status.	Fisher's exact tests to determine associations between the change in food security and key sociodemographic variables. Two-sided, two-sample tests of proportions to determine differences in proportions between who become food insecure and sociodemographic variables (95% confidence interval).
Specific Aim 2: Compare the prevalence of food insecurity among OHSU students who responded to the survey administered in the Spring-Fall of 2020 to OHSU students who responded to a similar survey in the Spring of 2018 and to estimates of national food insecurity prevalence.	**Hypothesis 2:** There will be a significant difference in percentage of OHSU students classified as food insecure by the US HFSSM 6-item short form in 2020 than in 2018 and the current 2019 national household food insecurity prevalence.	Two-sided, two-sample tests of proportions to determine if the prevalence of students who were food insecure before and after the shelter at home mandate differs from the 2018 survey results. A two-sided, one-sample test of proportion to compare the proportion of food insecure participants before and after the shelter-at-home mandate to the 2019 national food insecurity prevalence ($p<0.05$, 95% confidence interval).

Table 4: Statistical Analysis Summary

Specific Aim	Hypothesis	Statistical Test
Specific Aim 3: Determine the use of university and community resources that assist with food access by the OHSU student population.	**Hypothesis 3a:** The percentage of OHSU students who started to use at least one community resources after the shelter-at-home mandate will be significantly higher than the percentage of OHSU students who stopped using any community resource after the shelter-at-home mandate. The percentage of OHSU students who started using at least one university resources after the shelter-at-home will be significantly lower than the percentage of OHSU students who stopped using any university resource after the shelter-at-home mandate.	McNemar's test to determine change between both university and community resources before and after the shelter-at-home mandate ($p< 0.05$).
	Hypothesis 3b: A significant association will exist between change in university or community food resource use and sociodemographic factors including age, gender, ethnicity, race, children in the home, marital status, household income, current length in program, tuition waiver, and international student status.	Fisher's exact tests to determine associations between the change in use of university and community resources and key sociodemographic variables. Two-sided, two-sample tests of proportions to determine differences in proportions between those who went from using ≥ 1 resource to no resource and sociodemographic variables ($p<0.05$, 95% confidence interval).

Table 4: Statistical Analysis Summary

Specific Aim	Hypothesis	Statistical Test
Specific Aim 4: Determine the types of response behaviors and coping strategies used by students during the COVID-19 pandemic and the association of these response behaviors and coping strategies with food security status after enactment of the shelter-at-home mandate.	**Hypothesis 4a:** A significant association will exist between response behaviors used during the COVID-19 pandemic and food security status. Students who are food insecure will report higher rates of food-related stress, reduced motivation to cook healthy meals, reduced quality of foods purchased, and more difficulty accessing non-food related resources than their food secure peers.	Chi-square tests to determine associations between food security status and response behaviors ($p< 0.05$). Two-sided, two-sample tests of proportions to determine differences in proportions between food security status and response behavior (95% confidence interval).
	Hypothesis 4b: A significant association will exist between coping strategies used during the COVID-19 pandemic and food security status. Students who are food insecure will report higher rates of spending ≤$50 on groceries per week, leaving the home less often to grocery shop, that leaving the home less often impacts the amount of food needed in their home, purchasing less extra food, more interest in using a future campus food pantry, and preparing food less often.	Chi-square test to determine associations between food security status and coping strategies ($p< 0.05$). Two-sided, two-sample tests of proportions to determine differences in proportions between food security status and coping strategy (95% confidence interval).

Appendix F: Committee on World Food Security's Six Dimensions of Food Security Definitions[69]

Term[a]	**Definition**[b]
Availability	Having a quantity and quality of food sufficient to satisfy the dietary needs of individuals, free from adverse substances and acceptable within a given culture, supplied through domestic production or imports.
Access	Having personal or household financial means to acquire food for an adequate diet at a level to ensure that satisfaction of other basic needs are not threatened or compromised; and that adequate food is accessible to everyone, including vulnerable individuals and groups.

[a] Term list provides only two of the six dimensions of food insecurity.

[b] Definitions are reported exactly as stated by the Committee on World Food Security.

Appendix G: SNAP Eligibility Guidelines for University Students

SNAP Eligibility Criteria Based on General and Student Guidelines

- Meet 2021 Income Guidelines
  - AND must meet one of the following criteria OR
    - Undergrad with plans to work in field of study after graduation OR
    - Work an average of 20 hours a week (paid or self employed) OR
    - Unable to work due to physical/physiological difficulties OR
    - Receiving TANF[a] or participate in WIOA[b] approved program (none at OHSU) OR
    - Responsible for the care of a child (age requirements apply) OR
    - Be awarded workstudy and anticipate finding a position OR
    - Receiving unemployment compensation
- OR Meet 2021 Income Guidelines
  - AND must meet one of the temorary student eligibility criteria for SNAP
    - EFC[c] is $0 on the FAFSA in the 2020-2021 academic year OR
    - Eligible for federally financed work study in the 2020-2021 acadmic year

SNAP federal food assistance guidelines[72,73] and eligibility programs are provided to OHSU students.

[a] Temporary Assistance for Needy Families

[b] Workforce Innovation and Opportunity Act

[c] Expected Family Contribution