

THE COVID-19 PANDEMIC AND UNIVERSITY OF OREGON STUDENTS' FOOD  
SECURITY AND EATING BEHAVIORS

by

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## DISSERTATION ABSTRACT

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Title: The COVID-19 Pandemic and University of Oregon Students' Food Security and Eating Behaviors

Food insecurity is highly prevalent among U.S. college students and is associated with poor eating behaviors, physical and mental health, and academic performance. The COVID-19 pandemic has caused immense income loss in the United States. Income loss is associated with increased food insecurity. Little is known about how college students' food security and eating behaviors have changed during the pandemic. This cross-sectional study aimed to assess how University of Oregon (UO) students' food security and eating behaviors changed during the pandemic, as well as mediators of these potential changes between February 2020 and Fall 2020. In Fall 2020, 779 UO students responded to a Qualtrics survey that assessed their demographic characteristics, including undergraduate vs graduate status, international status, race and ethnicity, and sexual orientation, as well as food insecurity (USDA six-item short form food security scale) and eating behaviors (National College Health Assessment). Items asked students to report on these constructs for February 2020 and Fall 2020 (pre and during pandemic). Close to half of respondents reported food insecurity in February 2020 (46.8%) and Fall 2020 (47.3%). When examined by group, change in food security only varied significantly by students' sexual orientation. LGBTQIA+ students reported significantly

greater increases in food insecurity from February 2020 to Fall 2020 where heterosexual students had no change ( $p < .01$ ). Overall, there were no significant changes in any of the eating behaviors between February 2020 and Fall 2020. Change in income partially mediated change in vegetable consumption ( $p < .001$ ), but no other eating behaviors. Change in food security partially mediated changes in fruit ( $p < .001$ ), whole grain ( $p < .001$ ), and protein ( $p < .001$ ) consumption. These findings provide UO and other college administrators a better understanding of college students' food security and eating behaviors before and during the pandemic, and can inform future and existing programs to promote food security, and in turn, healthy eating among college students.

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## CHAPTER I

### INTRODUCTION

The SARS-CoV-2 Coronavirus which causes COVID-19 disease, is currently a global pandemic. Since the first case in the United States was confirmed in January 2020, the Centers for Disease Control and Prevention (CDC) have confirmed that over 31 million people have contracted and over 565,000 people have died from this disease in the United States alone (CDC, 2021). Like the governors of most states, on March 23, 2020, Oregon's Governor Kate Brown issued a statewide stay-at-home order to help slow the spread of COVID-19. This order included closing all non-essential activities that involved the public gathering of people, especially in an enclosed space (e.g., in-person education, dining in restaurants, shopping malls and sporting arenas). These closures resulted in widespread employment and ultimately income loss for millions of individuals in the United States. National data from the Bureau of Labor Statistics (BLS) from December 2020 showed that unemployment numbers have dropped from a high of 15.9 million (14.7%) in April 2020 to 10.7 million (6.7%), which is still almost double the unemployment rate from February 2020 (5.7 million or 3.5%) before the first state-wide stay-at-home orders went into effect (BLS, 2021). In November 2020 in Oregon, 126,800 adult Oregonians (6.0%) were unemployed, which has dropped from a high of 314,000 (14.9%) in April 2020 towards the beginning of the stay-at-home order, but is again almost double the Oregon unemployment rate from February 2020 (69,042 or 3.3%) (BLS, 2021). The loss of income associated with job loss may affect the quantity and quality of foods consumed, such as nutrient dense options like fruits and vegetables, whole grains and lean proteins that aid in health promotion (Coleman-Jensen et al.,

2014). Income loss has a profound negative effect on food security, leading to food insecurity for many people.

### **Food Insecurity**

The United States Department of Agriculture (USDA) defines food insecurity as the lack of ability to consistently purchase ample food to meet nutritional needs (USDA, 2019). Healthy People 2030 also indicates that food insecurity is considered a social determinant of health under the economic stability domain (Healthy People 2030). Social determinants of health are factors in a person's social and physical environment including where they live, work and are born that affect a person's health and quality of life. These factors are inequitably distributed across different populations which may be associated with poor eating behaviors and adverse health outcomes (Healthy People 2020). Food insecurity is associated with an increased consumption of foods of lower nutritional quality such as highly processed convenience foods and foods with high amounts of added sugar and fat (Widome et al., 2009). Food insecurity has also been shown to be associated with increased stress, thus increasing cortisol levels, which is the primary stress hormone in the body (Gundersen & Ziliak, 2015). Both poor eating behaviors and stress have been shown to contribute towards increased risks for chronic conditions, including high cholesterol, high blood pressure, heart disease, type 2 diabetes and many types of cancer (CDC, 2020; Gundersen & Ziliak, 2015; Pan et al., 2012). These chronic diseases are the leading causes of death in the United States (CDC, 2020). Poor nutrient intake due to food insecurity can also affect a person's brain health (Martin et al., 2016; Wong et al., 2016). Adverse outcomes including reduced cognitive function and poorer mental health outcomes such as, suicidal ideation and mood and anxiety disorders, have

been shown to be associated with poor nutrient intake for people experiencing food insecurity (Martin et al., 2016; Wong et al., 2016).

In 2019, the USDA reported that 35.2 million people (10.5%) in the United States lived in households experiencing food insecurity (USDA, 2020). More recent data from April 2020 showed that this number jumped to 125 million (38%), possibly due to the loss of income associated with the rise in unemployment rates during COVID-19 stay-at-home orders (Fitzpatrick et al., 2020). Pre-pandemic, low income individuals experienced higher rates of food insecurity than those in higher income brackets (31.6% compared to 12.3%; Coleman-Jensen et al., 2014). In the state of Oregon, about 400,000 (10%) Oregonians experienced food insecurity in 2019, and this number increased to 1 million (25%) in April 2020 at the start of the COVID-19 pandemic and stay-at-home order in March 2020 (Oregon State University, 2020).

### **College Students & Food Insecurity**

Prior to the pandemic, college students were a high-risk population for experiencing food insecurity (Bruening et al., 2017). The literature provides insights as to why this is the case. For example, while attending college, students are paying to study with limited time to work for pay, thus having a decrease in their own personal income, which may be associated with food insecurity (Morris et al., 2016). Also, the rising costs in higher education, and the increased need for students to take out loans to pay for their education have caused students to prioritize spending their money on non-food living expenses, thus increasing the likelihood of a person being food insecure (Broton & Goldrick-Rab, 2018; Goldrick-Rab et al., 2016). After graduation, these circumstances often change as college graduates are more likely to find higher paying jobs than the



average college student, which is likely to be associated with an improvement in food security (Abel & Dietz, 2019).

Rates of food insecurity among college students appears to differ based on a number of demographic factors. A systematic review by Bruening and associates in 2017, reported that 35-42% of college students globally experienced food insecurity, and students who were financially independent, students of color, and students who had children were more likely to report food insecurity. In the United States in 2014, college students who identified as racial or ethnic minorities (22.5%) were up to two times as likely to be food insecure compared to the national average (12.3%) (Coleman-Jensen et al., 2014). A 2019 study assessing food security at a large public university in the Southeast United States, showed that undergraduate and international students have lower food security compared to graduate and domestic students (Soldavini et al., 2019). Locally, data from a sample of 1,236 University of Oregon (UO) students gathered in 2017 found that 52% of the sample were experiencing low food security (Kashuba, 2017).

The high prevalence of food insecurity among college students should be a great concern to colleges and universities, as food insecurity has negative consequences, not only to students' health, but to academic outcomes. For example, Maroto et al (2015) found that community college students experiencing food insecurity had lower grade point averages (GPA) compared to food secure students. Another study found that food insecurity was highest amongst undergraduate students who reported lower GPAs (Patton-López et al., 2014). No research has examined the association between food insecurity and college dropout or graduation rates specifically, but there is much more

research on the topic of food insecurity among K-12 students than college students, and that evidence is clear that food security is inversely associated with many several academic performance outcomes (Cady, 2014).

For example, children in grades K-12 who are food insecure receive lower scores in math and reading and have more behavioral issues than children who are food secure (Ashiabi, 2005, Jyoti et al., 2005). Researchers state that there is no reason to think that these academic repercussions of food insecurity would be different among college students, as food insecurity and its associated outcomes can continue over a lifetime (Cady, 2014).

### **Programs on College Campuses Addressing Food Insecurity**

In recent years, colleges and universities have begun to provide services to students to reduce food insecurity. One program that has been implemented on many college campuses is a campus food pantry (Davis, Sisson & Clifton, 2020; Price et al., 2019). Another example is hiring staff specifically to help students enroll in the Supplemental Nutrition Assistance Program (SNAP) which provides monthly stipends to help low income students buy food. Despite the rise in these efforts on college campuses, only one study has assessed the impact of food assistance programs on college students' food insecurity (McArthur et al., 2019). A study at Appalachian State University found that college students who experienced food insecurity were appreciative of the food pantry and of the food that it provided because it allowed them to spend their money on rent and utilities, rather than food, and have all of their basic needs met (McArthur et al., 2019).

## **College Student Food Security during COVID-19 Pandemic**

Few studies have assessed how the COVID-19 pandemic is associated with college students' food security. A study in Spring 2020 at Texas Woman's University found that 34.5% of student respondents were food insecure, with the strongest predictors of food insecurity being a change in housing and being furloughed, laid off or losing part-time work (Owens et al., 2020). Another study surveyed students at six large research universities including the University of California, Berkeley and the University of Minnesota in Spring 2020 and found 22% of undergraduate and 19% of graduate students were food insecure (Soria et al., 2020). Students who identified as Black, Hispanic/Latinx, low income, first generation college student, LGBT+, or caregivers experienced higher rates of food insecurity than their peers who identified as non-Hispanic White, higher income, second generation college student or greater, heterosexual, or not caregivers (Soria et al., 2020). Several gaps in knowledge remain regarding how college students' food security has changed from pre-pandemic (February 2020) to during the pandemic and how these changes may vary by student characteristics, like student status (e.g., undergraduate, graduate), international student status, race and ethnicity, and sexual orientation.

## **College Student Eating Behaviors**

As mentioned previously, food security and less nutritious eating go hand in hand (Widome et al., 2009). Similar to their heightened risk for food insecurity pre-pandemic, college students were also at a heightened risk for unhealthy eating (Sogari et al., 2018). For many, college is the first time that they are independent, and away from the care of parents (Tinson & Nancarrow, 2007). College is a time when students are learning habits

and behaviors that they will take with them later into adulthood, including their eating behaviors. One study found that when adolescents move away from home to attend college, total fruit and vegetable intake decreased, while sugar sweetened beverage and candy intake increased (Winpenney et al., 2018). Another study found U.S. college students compared to people of the same age who were not enrolled in college were more likely to consume sugar sweetened beverages and foods with added sugar compared to healthier options like fresh fruits and vegetables because those foods were more appealing and were cheaper than healthier alternatives, suggesting that price is a barrier to healthier eating among college students pre-pandemic (Vilaro et al., 2018). Regular consumption of foods and beverages that contain added fat, sugar and salt can be a contributing factor towards the development of chronic diseases later in life like cardiovascular disease and type 2 diabetes (Moore et al., 2009).

The change in college students' eating behaviors from before to during the COVID-19 pandemic is unknown. Increased stress due to the COVID-19 pandemic and stay-at-home order may negatively affect their eating behaviors (Marroquín et al., 2020). Studies have shown that in times of stress, people are more likely to increase their consumption of highly palatable foods including those that are high in fat, sugar and salt as a way to cope, while at the same time decreasing consumption of healthy foods like fruits and vegetables (Oliver & Wardle, 1999; Cartwright et al., 2003). Also unknown is whether changes in students' incomes or food security mediate any potential changes in college students' eating behaviors from before the COVID-19 pandemic to during the COVID-19 pandemic. Investigating college students' eating behaviors from before to

during the pandemic will help uncover if and how they have changed, to inform future interventions to support healthy eating amongst college students.

## **Objectives**

The objectives of this cross-sectional study are to (a) assess how the COVID-19 pandemic stay-at-home order is related to UO students' food security and eating behaviors (b) examine how changes in food security vary by student characteristics including graduate versus undergraduate status, international student status, race and ethnicity, and sexual orientation, (c) if a change in income mediates the hypothesized changes in pre-COVID-19 pandemic and during pandemic food security, and (d) if change in food security or change in income mediates the hypothesized changes in February 2020 and Fall 2020 eating behaviors.

## **Research Questions**

### ***Research Question 1***

Specifically, this dissertation will interrogate the question: How have UO students' food security changed with COVID-19 stay-at-home orders when controlling for student status (e.g. undergraduate or graduate level student), international student status, race and ethnicity (i.e. White, Black, Latinx, Asian, or other), and sexual orientation (i.e. heterosexual, or lesbian, gay, bisexual, queer, pansexual or asexual or other [LGBQIA+])? I hypothesize that UO students will report a decrease in food security between February 2020, before COVID-19 stay-at-home orders went into effect, and August to November 2020 (referred to henceforth as Fall 2020).

### ***Research Question 2***

To the extent that there are changes in food security as a result of COVID-19, this dissertation will also interrogate the question: How do changes in food security vary by student characteristics including student status (e.g. undergraduate or graduate level student), international student status, race and ethnicity (i.e. White, Black, Latinx, Asian, or other), and sexual orientation (i.e. heterosexual, or LGBTQIA+)? Based on existing literature, I hypothesize that the decrease in food security will be greater for students who are undergraduates, international, racial and ethnic minorities, or sexual minorities (i.e., LGBTQIA+), between February 2020 and Fall 2020 compared with students who are in graduate programs, domestic, non-Hispanic White, or heterosexual (Brown et al., 2016, Coleman-Jensen et al., 2014 and Soldavini et al., 2019).

### ***Research Question 3***

This dissertation will also interrogate the question: Does change in income mediate the association between February 2020 food security and Fall 2020 food security when controlling for student status (e.g. undergraduate or graduate level student), international student status, race and ethnicity (i.e. White, Black, Latinx, Asian, or other), and sexual orientation (i.e. heterosexual, or LGBTQIA+)? Based on existing literature, I hypothesize that loss in income will mediate the hypothesized decrease in food security between February 2020 food security and Fall 2020 food security (Coleman-Jensen et al., 2014).

### ***Research Question 4***

This dissertation will also interrogate the question: How have UO students' eating behaviors changed with COVID-19 stay-at-home orders when controlling for student

status (e.g. undergraduate or graduate level student), international student status, and race and ethnicity (i.e. White, Black, Latinx, Asian, or other)? Based on the existing literature, I hypothesize that UO students will experience a decrease in the consumption of healthy foods including, fruits and vegetables, whole grains and lean protein foods, and increase consumption of restaurant meals from a counter or drive-through, sugar sweetened beverages, and energy drinks from February 2020 to Fall 2020 (Oliver & Wardle, 1999; Cartwright et al., 2003).

### ***Research Question 5***

Finally, this dissertation will interrogate the question: Do change in income and change in food security mediate the change between February 2020 eating behaviors and Fall 2020 eating behaviors when controlling for student status (e.g. undergraduate or graduate level student), international student status, race and ethnicity (i.e. White, Black, Latinx, Asian, or other)? Based on existing literature, I hypothesize that loss in income and loss in food security will mediate the hypothesized decrease in consumption of healthy foods between February 2020 and Fall 2020 (Oliver & Wardle, 1999; Cartwright et al., 2003).

## CHAPTER II

### METHODOLOGY

#### **Participant Recruitment**

Current UO students were invited to complete a survey that was developed to assess food security and eating behaviors. Data collection started mid-August 2020. Recruitment of potential participants included a campus wide digital article, email recruitment through individual programs, and social media posts. Specifically, an “Around the O” story on the study with a link to the survey was shared with all UO emails on August 24, 2020. Every program coordinator was emailed in October and November, requesting that they share the recruitment email with their program’s student listserv and program’s social media accounts.

Once students clicked on the link to the survey, they were taken to the participant informed consent document. Potential participants who selected a radio button that read “I consent to participate in this study,” thereby indicating their consent to participation, were asked two eligibility questions including their age and if they were a current UO student. If the participant confirmed that they were a legal adult (18 years old or older) and were a current UO student, then they were redirected to the full 57-question survey (see Appendix A). The survey took approximately 15 minutes to complete. Overall, the survey assessed students’ income, living arrangements, food security, eating behaviors and grocery shopping habits before the COVID-19 stay-at-home order in February 2020 and at the time they completed the survey in Fall 2020. Although the survey was open from August to November 2020, the large majority of active participation in this survey was from October to November 2020 after program coordinators distributed recruitment



materials to students on respective listservs. Students who completed at least 80% of the survey and shared their UO email were entered into drawings to receive one of 65 \$20 gift cards to a Safeway grocery store. Odds of winning a gift card in the drawings was not disclosed to students as the exact odds of winning were dependent on the number of participants who completed at least 80% of the survey. Participants' names and UO email addresses were collected via a separate survey, not linked to survey responses. The UO Institutional Review Board approved this study.

### **Funding**

Gift card drawing incentives were funded by three internal sources through the UO. The UO Food Studies Program and Counseling Psychology and Human Services Program each provided \$500, and the UO Food Security Task Force provided \$300. A total of \$1,300 was used to purchase the Safeway e-gift cards, which were distributed to participants via email through the Prevention Science Institute.

### **Measures**

#### ***Demographic Characteristics***

Demographic characteristics including age, gender (open answer, condensed to six categories based on a qualitative analysis of students' responses), race and ethnicity (White/European American, Black/African American, Native American/American Indian/Alaska Native, Asian/Asian American, Native Hawaiian/Pacific Islander, Hispanic/Latinx, Multiracial or Other), sexual orientation (heterosexual, lesbian, gay, bisexual, pansexual, asexual, questioning or other), student status (undergraduate, masters' student, doctoral student, graduate certificate, law student or other) and international student status (yes or no) were assessed. Race, ethnicity and sexual

orientation questions came from the CDC's National Health Interview Survey of 2019 (CDC, 2019). The survey also asked students to recall their income (eleven categories ranging from no income, and increasing in \$500 increments to \$5,000 or more per month) and hours worked per week (0-70 hours per week) before the COVID-19 stay-at-home order in February 2020 and at the time they completed the survey which was open from late August to mid-November 2020 (CDC, 2013, 2015).

### ***Food Security***

Food security was assessed by using a set of five reliable and valid food security questions developed and used by the USDA and the American College Health Association's (ACHA) National College Health Assessment (NCHA), which have demonstrated good internal consistency (Cronbach alpha = .86) (ACHA, 2021; Gulliford et al., 2004; USDA, 2012). One question asked was "The food that I bought just didn't last, and I didn't have money to get more" with answer choices including 2 = *often true*, 1 = *sometimes true* and 0 = *never true* (USDA, 2012). Participants were asked to recall information related to their food security in February 2020 before the Oregon COVID-19 stay-at-home order and in Fall 2020.

Although the USDA's version of the food security measure included six questions, this study used the modified NCHA five question format to measure food security (ACHA, 2021). The USDA's original six question short form survey had a question that was conditional (a "what if" question); if respondents answered "yes" to the question "Do you cut the size of your meals or skip meals due to not enough money to buy food?" then they were instructed to answer a question asking how often they do this activity. In the modified NCHA five question format, these questions were combined. To

measure food security, the five food security questions were asked twice, once in February 2020 and again for Fall 2020. These questions were used to create two separate food security scores, one for February 2020 and one for Fall 2020. The original USDA short form food security survey which used a six question format created a food security score with each positive answer to food security being affected as getting one point, with scores ranging from zero to six. Since the survey for this study used the NCHA's modified five question set with one question being a combination of two questions from the USDA question set, if a student answered positively that food security was affected to the above mentioned modified question, they would receive two points. A score of 0 or 1 meant high or marginal food security, scores 2 through 4 equated to low food security and a score of 5 or 6 as very low food security, and there were two scores created to measure food security; one for February 2020 and one for Fall 2020.

### ***Eating Behaviors***

Eating behaviors were measured by eight questions. Four questions from the ACHA's NCHA (ACHA, 2021) assessed daily fruit, vegetable, sugar sweetened beverage, and energy drink intake. The questions have been shown to produce valid and reliable responses (ACHA, 2013). Fruit, vegetable, and sugar sweetened beverage questions were asked in the same style, for example, "How many servings of fruit did you eat (in February 2020, or currently) on average per day? One serving is a medium piece of fresh fruit; ½ cup of fresh, frozen or canned fruit; ¼ cup of dried fruit; or ¾ cup of 100% fresh fruit juice," with a drop-down menu of choices from 0 to 6 or more servings per day. Energy drink intake was assessed with the question "In the month of February 2020, how many days did you drink energy drinks or energy shots (for

example: Red Bull, Monster, Full Throttle, 5 Hour Energy, Rockstar Energy Shot, or Full Throttle Energy Shot, etc.)” with a drop-down menu of choices from 0 to 29 days. One question assessing daily whole grain intake was edited from the NHANES Dietary Screener Questionnaire (NHANES, 2020) to follow the same question flow as the previously described ACHA questions. The question has been shown to produce valid and reliable responses (Thompson et al., 2017). Three questions assessing protein food intake, water intake, and consumption of restaurant meals from a counter or drive-through were developed by the principal investigator. These questions were developed in the same style as the ACHA questions, where respondents had a drop-down menu with number of daily servings for each item. Participants were asked to recall the approximate daily serving amounts of fruits, vegetables, whole grains, proteins, water, sugar sweetened beverages and energy drinks consumed each day and amount of monthly consumption of restaurant meals from a counter or drive-through before the COVID-19 stay-at-home order and Fall 2020.

### **Statistical Analyses**

All analyses were conducted using IBM SPSS Version 25. Descriptive statistics were calculated for all study variables and demographic characteristic variables. Variables that have missing cases in excess of 10% of the sample were assessed with bivariate tests to examine if there are any patterns to the missingness. A significance level of  $p < 0.05$  was used to determine the statistical significance of findings for all inferential analyses. For all analysis of covariance tests since there are only two levels of within subjects factors being assessed, sphericity is assumed, and Mauchly’s sphericity test was not necessary.

Certain demographic variables were recoded for analyses. Student status was collapsed into two categories including: undergraduate and graduate students (including: masters, graduate certificate, law and doctoral students). Race and ethnicity were also collapsed into five categories including: non-Hispanic White, Black/African American, Hispanic/Latinx, Asian, and other (which included: Native American/American Indian/Alaska Native, Native Hawaiian/Pacific Islander, multiracial individuals who stated they were more than one of the categories in the survey question, and people who wrote in their race and ethnicity that did not fit into any of the other categories). Sexual orientation was collapsed into heterosexual, or a member of the LGBTQIA+ (including pansexual) community.

A change in income score was calculated from February 2020 to Fall 2020 income. Income was assessed with eleven income response options for participants to choose from. A continuous change score from negative eleven to positive eleven was created, with negative values showing a loss of income and positive numbers showing a gain in income from February 2020 to Fall 2020. A change in food insecurity score was calculated from February 2020 to Fall 2020 food security. Food security scores (as previously mentioned) from zero to six were created for both February 2020 and Fall 2020. A continuous change score from negative six to positive six, with more negative values showing a decrease in food insecurity (i.e. gain in food security) and positive numbers indicating an increase in food insecurity (i.e. loss in food security) from February 2020 to Fall 2020.

To address research question (RQ) 1, a repeated measures analysis of covariance (ANCOVA) was conducted to assess the changes between pre-COVID-19 pandemic

stay-at-home order and Fall 2020 food security among UO students. The within-subject factor for this analysis was “time,” with two levels: pre-COVID-19 food security score and Fall 2020 food security score. The between-subjects factors, also known as covariates, for this research question were student status (e.g. undergraduate or graduate level student), international student status, race and ethnicity (i.e. non-Hispanic White, Black/African American, Hispanic/Latinx, Asian/Asian American and other), and sexual orientation (i.e. heterosexual, or LGBQIA+).

To address RQ 2, four repeated measures ANCOVAs were conducted to assess how food security changes from February 2020 to Fall 2020 may have differed based on student status (e.g. undergraduate or graduate level student), international student status, race and ethnicity (i.e. non-Hispanic White, Black/African American, Hispanic/Latinx, Asian/Asian American and other ), and sexual orientation (i.e. heterosexual, or LGBQIA+). The within-subject factor for all analyses was the measure “time,” with two levels: pre-COVID-19 food security score and Fall 2020 food security score. Each of the demographic characteristics including student status, international student status, race and ethnicity, and sexual orientation, were a between-subjects factor individually for each of the four repeated measures ANCOVAs. When each variable was not a between-subjects factor, it was included as a covariate.

To address RQ 3, a mediation analysis was conducted to assess if the association between February 2020 food security and Fall 2020 food security was mediated by a change in income from February 2020 to Fall 2020 when controlling for student status (e.g. undergraduate or graduate level student), international student status, race and ethnicity (i.e. non-Hispanic White, Black/African American, Hispanic/Latinx,

Asian/Asian American and other), and sexual orientation (i.e. heterosexual, or LGBTQIA+). Mediation typically requires either a longitudinal study, or clear temporality of the independent variable before the mediator and the dependent variable (Bind et al., 2016). This cross sectional study collected pre-pandemic and during-pandemic data at the same time point. Thus, the results of this study are limited to associations rather than causal inferences. To test this mediation, the SPSS macro “process” program developed by Andrew Hayes was used to test the indirect effect of a change of income from February 2020 to Fall 2020 on the direct effect association between February 2020 food security and Fall 2020 food security (Hayes & Rockwood, 2017). A bootstrap estimation with 5,000 samples was used to test the indirect effect.

To address RQ 4, eight repeated measures ANCOVAs were conducted to assess the changes between February 2020 and Fall 2020 consumption of servings each of the following: 1) fruits, 2) vegetables, 3) whole grains, 4) proteins, 5) water, 6) sugar sweetened beverages, 7) energy drinks and 8) restaurant meals from a counter or drive-through, when controlling for student status (e.g. undergraduate or graduate level student), international student status, and race and ethnicity (i.e. non-Hispanic White, Black/African American, Hispanic/Latinx, Asian/Asian American and other). The within-subject factor for each of the analyses was the measure “time,” with two levels: pre-COVID-19 food or beverage intake and Fall 2020 food or beverage intake. The between-subjects factors, also known as covariates, were student status, international student status, and race and ethnicity.

To address RQ 5, sixteen total mediation analyses were conducted to assess if the association between February 2020 and Fall 2020 eating behaviors for the consumption

of servings of: 1) fruits, 2) vegetables, 3) whole grains, 4) proteins, 5) water, 6) sugar sweetened beverages, 7) energy drinks and 8) restaurant meals from a counter or drive-through were mediated by a change in income and a change in food security from February 2020 to Fall 2020 when controlling for student status (e.g. undergraduate or graduate level student), international student status, and race and ethnicity (i.e. non-Hispanic White, Black/African American, Hispanic/Latinx, Asian/Asian American and other). Similar to the analyses in research question three, these analyses are associations and not causal inferences. Eight of the mediation models assessed each of the eight eating behaviors with the change of income as the mediator, and the other eight mediation models assessed each of the eight eating behaviors with the change in food security as the mediator. To test these mediations, the SPSS macro “process” program developed by Andrew Hayes was used to test the indirect effects of a change of income and change in food security from February 2020 to Fall 2020 on the direct effect between February 2020 eating behaviors and Fall 2020 eating behaviors for each of the eight eating behaviors (Hayes & Rockwood, 2017). A bootstrap estimation with 5,000 samples was used to test the indirect effect.



## CHAPTER III

### RESULTS

#### **Characteristics of Survey Respondents**

A total of 779 current UO students completed the survey ( $M_{age} = 23.37 \pm 6.15$  years, min = 18, max = 67). The majority of respondents were female (75.5%), non-Hispanic White (66.4%) and identified as heterosexual (68.7%). Nearly three-fourths of students were undergraduates (73.3%) and almost all were domestic (i.e. not international) students (97%). Over half of the respondents identified as non-Hispanic White (66.4%), while 12.3% identified as Multiracial, 11.0% identified as Asian or Asian American, 4.7% identified as Hispanic or Latinx, and 1.7% identified as Black or African American. Additional demographic characteristics of the sample are detailed in Table 1.

Regarding change in income from February 2020 to Fall 2020, 34.5% of students reported a decrease, 41.6% reported no change, and 23.4% reported an increase. In February 2020, 46.8% of students reported food insecurity, and 47.3% reported food insecurity in Fall 2020. Regarding change in food insecurity from February 2020 to Fall 2020, 22.2% of students reported an increase, 58% reported no change, and 19.6% reported a decrease.

Tables 2 and 3 below describe the eating behaviors of UO students in February 2020 and Fall 2020. In February 2020, all UO students were consuming on average less than 2 servings of fruit ( $M_{serving} = 1.63 \pm 1.08$ ), vegetables ( $M_{serving} = 1.95 \pm 1.21$ ), whole grain products ( $M_{serving} = 1.97 \pm 1.26$ ) and protein foods ( $M_{serving} = 1.98 \pm 0.92$ ) each day.

**Table 1**

*Demographic Characteristics of University of Oregon Student Survey Respondents (n = 779)*

	<i>n (%)</i>
<b>Gender</b>	
Female	588 (75.5)
Male	155 (19.9)
Nonbinary	32 (4.1)
Agender	2 (0.3)
Transgender Male	1 (0.1)
Missing	1
<b>Race and Ethnicity</b>	
Non-Hispanic White	517 (66.4)
Multiracial	96 (12.3)
Asian/Asian American	86 (11.0)
Hispanic/Latinx	37 (4.7)
Native American/American Indian/Alaska Native	16 (2.1)
Black/African American	13 (1.7)
Other	11 (1.4)
Native Hawaiian/Pacific Islander	3 (0.4)
Missing	0
<b>Sexual Orientation</b>	
Heterosexual	535 (68.7)
Bisexual	122 (15.7)

**Table 1 (continued)**

	<i>n</i> (%)
Queer	44 (5.6)
Pansexual	29 (3.7)
Lesbian	19 (2.4)
Gay	13 (1.7)
Asexual	9 (1.2)
Other	6 (0.8)
Missing	2
<b>Student Status</b>	
Undergraduate-Freshman (0-44 credits)	48 (6.2)
Undergraduate-Sophomore (45-89 credits)	95 (12.2)
Undergraduate-Junior (90-134 credits)	175 (22.5)
Undergraduate-Senior (135 credits or more)	253 (32.5)
Post-Baccalaureate	2 (0.3)
Graduate-Masters	90 (11.6)
Graduate-Doctoral	106 (13.6)
Graduate-Certificate Program	1 (0.1)
Law Student	9 (1.2)
Missing	0
<b>International Student Status</b>	
No	756 (97.0)
Yes	23 (3.0)
Missing	0

In February 2020 students were also consuming about five cups of plain water ( $M_{cups} = 5.20 \pm 2.48$ ) and less than one serving of sugar sweetened beverages ( $M_{serving} = 0.89 \pm 1.06$ ) each day, and were consuming energy drinks less than two days each month ( $M_{days} = 1.91 \pm 4.83$ ). In February 2020, 15.3% never or rarely consumed restaurant meals from a counter or drive-thru, while 12.8% stated they had this type of food one time per month. One-third (34.5%) of students had restaurant meals from a counter or drive through two to three times per month while 28.2% had these meals one to two times per week. Less than ten percent (9.2%) of students stated that they had restaurant or drive-through meals more frequently than one to two times per week, and no students stated that they ate these types of meals three or more times each day in February 2020.

In Fall 2020, all UO students were again consuming on average less than 2 servings of fruit ( $M_{serving} = 1.59 \pm 1.12$ ), vegetables ( $M_{serving} = 1.92 \pm 1.21$ ), whole grain products ( $M_{serving} = 1.90 \pm 1.27$ ) and protein foods ( $M_{serving} = 1.86 \pm 0.94$ ) each day. In Fall 2020 students were also consuming about five cups of plain water ( $M_{cups} = 5.28 \pm 2.50$ ) and less than one serving of sugar sweetened beverages ( $M_{serving} = 0.87 \pm 1.10$ ) each day, and were consuming energy drinks less than two days each month ( $M_{days} = 1.27 \pm 3.94$ ). In Fall 2020, 20.8% never or rarely consumed restaurant meals from a counter or drive-thru, while 15.5% stated they had this type of food one time per month. One-third (34.0%) of students continued to have restaurant meals from a counter or drive through two to three times per month while 20.3% had these meals one to two times per week. Less than ten percent (9.4%) of students stated that they had restaurant or drive-through meals more frequently than one to two times per week, and no students stated that they ate these types of meals three or more times each day in Fall 2020.

**Table 2**

*Average Servings of Each Food or Beverage Type Consumed Each Day for University of Oregon Students in February 2020 and Fall 2020 (n = 779)*

	February 2020	Fall 2020
	M (SD)	
Fruit	1.63 (1.08)	1.59 (1.12)
Vegetables	1.95 (1.21)	1.92 (1.21)
Whole Grain Products	1.97 (1.26)	1.90 (1.27)
Protein Foods	1.98 (0.92)	1.86 (0.94)
Plain Water (in cups)	5.20 (2.48)	5.28 (2.50)
Sugar Sweetened Beverages	0.89 (1.06)	0.87 (1.10)
Energy Drinks (days per month)	1.91 (4.83)	1.27 (3.94)

### **RQ 1 Results: Overall Changes in Food Insecurity**

To answer RQ 1, a repeated measures ANCOVA test showed that, overall, this sample of students did not experience a significant change in food insecurity,  $F(1, 764) = 1.64, p = .201$ , when controlling for student status, international student status, race and ethnicity and sexual orientation. Results can be found in Table 2 below.

### **RQ 2 Results: Changes in Food Insecurity by Student Characteristics**

To answer RQ 2, four repeated measures ANCOVA tests showed that there were significant differences in changes in food insecurity by students' sexual orientation, controlling for student status, international student status and race and ethnicity,  $F(1, 764) = 7.16, p < .01$ .

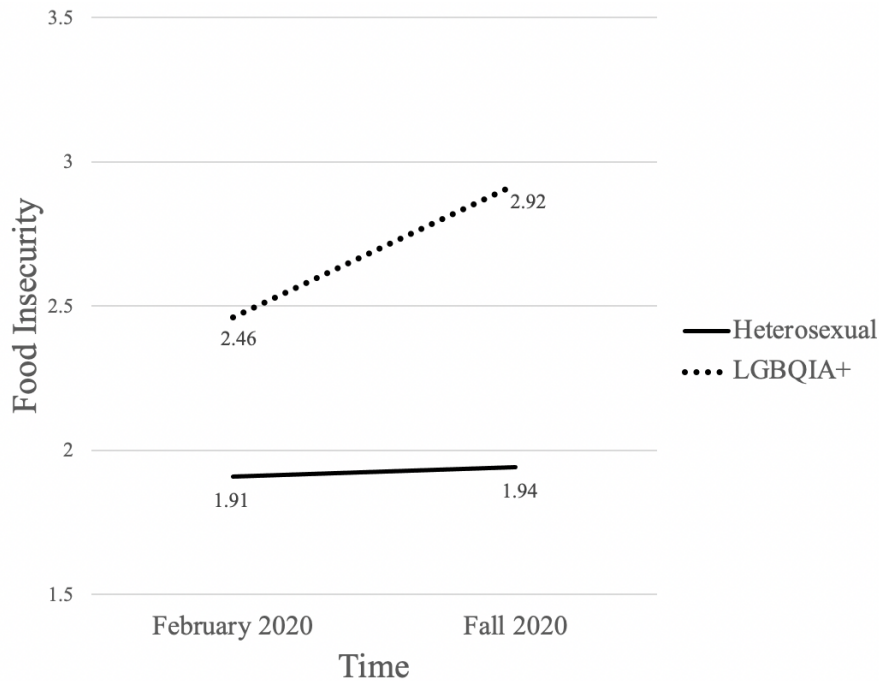
**Table 3.***Restaurant Meal Consumption in February 2020 and Fall 2020 (n = 779)*

	February 2020	Fall 2020
	<i>n (%)</i>	
Never or Rarely	119 (15.3)	162 (20.8)
One time per month	100 (12.8)	121 (15.5)
Two to three times per month	269 (34.5)	265 (34.0)
One to two times per week	220 (28.2)	158 (20.3)
Three to four times per week	48 (6.2)	59 (7.6)
Five to six times per week	13 (1.7)	8 (1.0)
One time per day	8 (1.0)	4 (0.5)
Two times per day	2 (0.3)	2 (0.3)
Three or more times per day	0	0
Missing	0	0

Specifically, there was a significant increase in food insecurity for students who identified as sexual minorities (e.g. LGBTQIA+), but no significant change in food insecurity for heterosexual students from February 2020 to Fall 2020. Figure 1 below shows the differences in change in food insecurity over time by sexual orientation. Food insecurity did not vary by student status (e.g. undergraduate, graduate),  $F(1, 764) = 0.50$ ,  $p = .481$ , international student status,  $F(1, 764) = 1.24$ ,  $p = .266$ , or race and ethnicity  $F(1, 764) = 1.10$ ,  $p = .295$ , controlling for student status, international student status, race and ethnicity and sexual orientation when each was not the independent variable in the model. Results for RQ 1 and RQ 2 are detailed in Table 4 below.

**Figure 1**

*Changes in Food Insecurity Over Time by Sexual Orientation*



*Note.* LGBQIA+ = sexual minorities. Students who identified as LGBQIA+ had a significant increase in food insecurity from February 2020 to Fall 2020, and heterosexual students did not ( $F(1, 764) = 7.16, p < .01$ ).

### **RQ 3 Results: Change in Income as a Mediator of Food Insecurity Change**

Results for RQ 3 (Figure 2), indicated that change in income did not mediate the change in food insecurity between February 2020 and Fall 2020, when controlling for student status, international student status, race and ethnicity and sexual orientation. The hypothesized change in income mediator was not associated with February 2020 food insecurity ( $\beta = 0.02, SE = .03, 95\% CI [-.04, .07], p = .57$ ), but was significantly associated with Fall 2020 food insecurity ( $\beta = -0.23, SE = .04, 95\% CI [-.31, -.16], p < .001$ ).

**Table 4**

*Change in Food Insecurity from February 2020 to Fall 2020 by University of Oregon  
Student Characteristics (n = 779)*

Variable	<i>MS</i>	<i>df</i>	<i>F</i>	<i>p</i>
<b>RQ1 Model: Overall Food Insecurity Change</b>				
Food Insecurity Change	2.91	1	1.64	.201
<b>Covariates</b>				
Student Status	163.36	1	18.48	.000***
International Student Status	0.82	1	0.09	.761
Race and Ethnicity	14.96	1	1.69	.194
Sexual Orientation	203.96	1	23.07	.000***
Error	8.84	764		
<b>RQ2 Model 1: Food Insecurity Change by Student Status</b>				
Food Insecurity Change x Student Status	0.88	1	0.50	.481
<b>Covariates</b>				
International Student Status	0.82	1	0.09	.761
Race and Ethnicity	14.96	1	1.69	.194
Sexual Orientation	203.96	1	23.07	.000***
Error	8.84	764		



**Table 4 (continued)**

Variable	<i>MS</i>	<i>df</i>	<i>F</i>	<i>p</i>
<b>RQ 2 Model 2: Food Insecurity Change by International Student Status</b>				
Food Insecurity Change x International Student Status	2.20	1	1.24	.266
<b>Covariates</b>				
Student Status	163.36	1	18.48	.000***
Race and Ethnicity	14.96	1	1.69	.194
Sexual Orientation	203.96	1	23.07	.000***
Error	8.84	764		
<b>RQ 2 Model 3: Food Insecurity Change by Race and Ethnicity</b>				
Food Insecurity Change x Race and Ethnicity	1.95	1	1.10	.295
<b>Covariates</b>				
Student Status	163.36	1	18.48	.000***
International Student Status	0.82	1	0.09	.761
Sexual Orientation	203.96	1	23.07	.000***
Error	8.84	764		
<b>RQ 2 Model 4: Food Insecurity Change by Sexual Orientation</b>				
Food Insecurity Change x Sexual Orientation	12.70	1	7.16	.008**
<b>Covariates</b>				
Student Status	163.36	1	18.48	.000***
International Student Status	0.82	1	0.09	.761

**Table 4 (continued)**

Variable	<i>MS</i>	<i>df</i>	<i>F</i>	<i>p</i>
Race and Ethnicity	14.96	1	1.69	.194
Error	8.84	764		
Error	1.78	764		

*Note.* Results for Repeated Measures Analysis of Covariance (ANCOVA) tests are shown. \*\* =  $p < .01$ , \*\*\* =  $p < .001$ , *MS* = mean square, *df* = degrees of freedom, *F* = variation between sample means, *p* = probability of observing a result as big as the one which is obtained in the experiment, assuming null hypothesis is true.

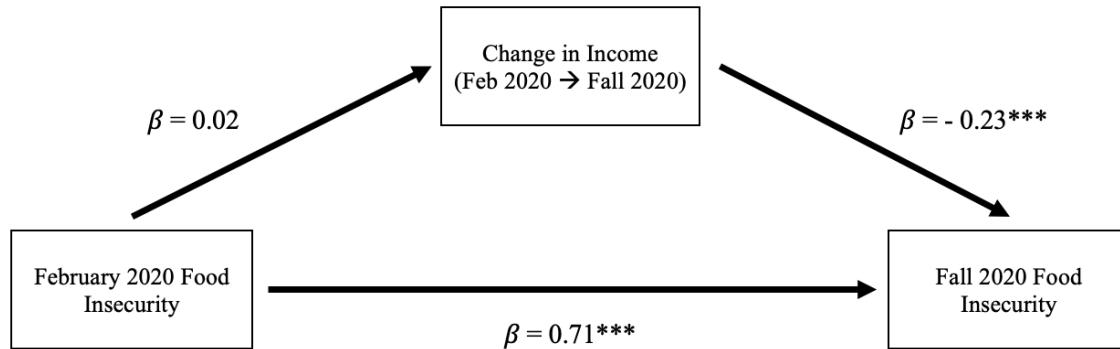
The direct effect of February 2020 food insecurity on Fall 2020 food security was significant ( $\beta = 0.71$ ,  $SE = .03$ , 95% CI [.65, .76],  $p < .001$ ).

#### **RQ 4 Results: Overall Changes in Eating Behaviors**

To answer RQ 4 (Table 5), eight repeated measures ANCOVA tests showed that there were no significant differences in changes in eating behaviors when controlling for student status, international student status, and race and ethnicity. Students did not experience a significant change in any of the eating behaviors: fruits ( $p = .573$ ), vegetables ( $p = .873$ ), whole grain products ( $p = .596$ ), protein foods ( $p = .222$ ), plain water ( $p = .852$ ), sugar sweetened beverages ( $p = .171$ ), energy drinks ( $p = .406$ ), and restaurant meals ( $p = .561$ ), when controlling for student status, international student status, and race and ethnicity.

**Figure 2**

*Change in Income Did Not Mediate the Change in Food Insecurity between February 2020 and Fall 2020 Among University of Oregon Students.*



Note. \*\*\* =  $p < .001$ .

### **RQ 5 Results: Change in Income, Food Insecurity as Mediators of Eating Behavior Changes**

To answer RQ 5, sixteen total mediation models showed that change in income and change in food insecurity did mediate the change in a few different eating behaviors from February 2020 to Fall 2020. Figure 3 below shows that change in income did partially mediate the change in vegetable consumption between February 2020 ( $\beta = -0.13$ ,  $SE = .05$ , 95% CI  $[-.24, -.03]$ ,  $p < .01$ ), and Fall 2020 ( $\beta = 0.06$ ,  $SE = .02$ , 95% CI  $[.03, .10]$ ,  $p < .001$ ), when controlling for student status, international student status and race and ethnicity. These results indicate that the indirect effect of change in income was significant and negative ( $\beta = -0.01$ ,  $SE = .01$ , 95% CI  $[-.02, -.01]$ ). The direct effect of February 2020 vegetable consumption on Fall 2020 vegetable consumption was also significant and positive ( $\beta = 0.69$ ,  $SE = .03$ , 95% CI  $[.64, .74]$ ,  $p < .001$ ), and so was the total effect of the model ( $\beta = 0.68$ ,  $SE = .03$ , 95% CI  $[.62, .73]$ ,  $p < .001$ ).

**Table 5**

*Changes in Eating Behaviors Among University of Oregon Students from February 2020 to Fall 2020 (n = 779)*

Variable	<i>MS</i>	<i>df</i>	<i>F</i>	<i>p</i>
<b>RQ 4: Fruit Consumption</b>				
Fruits	0.13	1	0.32	.573
Error	0.41	771		
<b>Covariates</b>				
Student Status	11.17	1	5.61	.018*
International Student Status	1.51	1	0.76	.384
Race and Ethnicity	3.33	1	1.67	.196
Error	1.99	771		
<b>RQ 4: Vegetable Consumption</b>				
Vegetables	0.02	1	0.04	.837
Error	0.46	768		
<b>Covariates</b>				
Student Status	77.45	1	33.19	.000***
International Student Status	0.79	1	0.34	.561
Race and Ethnicity	5.78	1	2.48	.043*
Error	2.33	768		
<b>RQ 4: Whole Grain Consumption</b>				
Whole Grain Products	0.13	1	0.28	.596
Error	0.48	770		

**Table 5 (continued)**

Variable	<i>MS</i>	<i>df</i>	<i>F</i>	<i>p</i>
<b>Covariates</b>				
Student Status	5.45	1	2.02	.156
International Student Status	0.14	1	0.05	.821
Race and Ethnicity	4.19	1	1.55	.213
Error	2.70	770		
<b>RQ 4: Protein Consumption</b>				
Proteins	0.41	1	1.50	.222
Error	0.27	770		
<b>Covariates</b>				
Student Status	4.44	1	3.06	.081
International Student Status	4.58	1	3.15	.076
Race and Ethnicity	0.08	1	0.06	.814
Error		770		
<b>RQ 4: Plain Water Consumption</b>				
Plain Water (in cups)	0.04	1	0.04	.852
Error	1.15	771		
<b>Covariates</b>				
Student Status	83.39	1	7.52	.006**
International Student Status	14.42	1	1.30	.254
Race and Ethnicity	39.00	1	3.52	.061
Error	11.10	771		

**Table 5 (continued)**

Variable	<i>MS</i>	<i>df</i>	<i>F</i>	<i>p</i>
<b>RQ 4: Sugar Sweetened Beverage Consumption</b>				
Sugar Sweetened Beverages	0.66	1	1.87	.171
Error	0.35	770		
<b>Covariates</b>				
Student Status	0.21	1	0.11	.741
International Student Status	2.41	1	1.28	.258
Race and Ethnicity	14.57	1	7.76	.005**
Error	1.88	770		
<b>RQ 4: Energy Drink Consumption</b>				
Energy Drinks (days per month)	5.23	1	0.69	.406
Error	7.55	770		
<b>Covariates</b>				
Student Status	383.825	1	12.51	.000***
International Student Status	32.10	1	1.05	.307
Race and Ethnicity	70.54	1	2.30	.130
Error	30.69	770		
<b>RQ 4: Restaurant Meal Consumption</b>				
Restaurant Meals	0.29	1	0.34	.561
Error	0.87	771		
<b>Covariates</b>				
Student Status	3.54	1	1.42	.233
International Student Status	4.97	1	2.00	.158

**Table 5 (continued)**

Variable	<i>MS</i>	<i>df</i>	<i>F</i>	<i>p</i>
Race and Ethnicity	5.04	1	2.03	.155
Error	2.49	771		

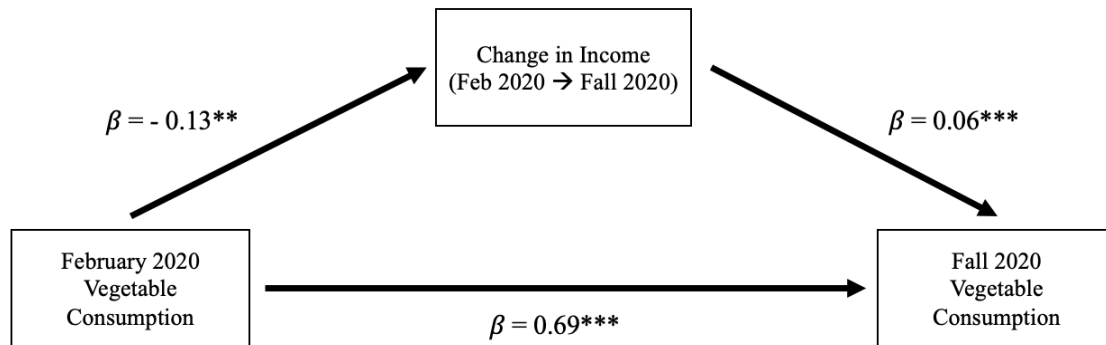
*Note.* \* =  $p < .05$ , \*\* =  $p < .01$ , \*\*\* =  $p < .001$ , *MS* = mean square, *df* = degrees of freedom, *F* = variation between sample means, *p* = probability of observing a result as big as the one which is obtained in the experiment, assuming null hypothesis is true.

Due to the fact that both the indirect and direct effects were significant, it is concluded that this is a partial mediation model. The change in income accounts for 1.2% of the total effect of this model. Thus, when UO students' income decreased from February 2020 to Fall 2020, vegetable consumption also decreased from February 2020 to Fall 2020. Change in income did not mediate the effect of February 2020 eating behaviors to Fall 2020 eating behaviors for any of the other foods and beverages including: fruit, whole grain, protein, water, sugar sweetened beverages, energy drinks and restaurant meals, and are shown below in Table 6.

Figure 4 below shows that change in food insecurity did partially mediate the change in fruit consumption between February 2020 ( $\beta = 0.24$ ,  $SE = .06$ , 95% CI [.12, .36],  $p < .001$ ), and Fall 2020 ( $\beta = - 0.11$ ,  $SE = .02$ , 95% CI [-.14, -.08],  $p < .001$ ), when controlling for student status, international student status and race and ethnicity. These results indicate that the indirect effect of change in food insecurity was significant and negative ( $\beta = - 0.03$ ,  $SE = .01$ , 95% CI [-.05, -.01]).

### Figure 3

*Change in Income Did Mediate the Change in Vegetable Consumption from February 2020 to Fall 2020 Among University of Oregon Students.*



*Note.*  $** = p < .01$ ,  $*** = p < .001$ . A decrease in monthly student income from February 2020 to Fall 2020 was associated with a decrease in student vegetable consumption from February 2020 to Fall 2020.

The direct effect of February 2020 fruit consumption on Fall 2020 fruit consumption was also significant and positive ( $\beta = 0.71$ ,  $SE = .03$ , 95% CI [.65, .76],  $p < .001$ ), and so was the total effect of the model ( $\beta = 0.68$ ,  $SE = .03$ , 95% CI [.62, .73]),  $p < .001$ ). Due to the fact that both the indirect and direct effects were significant, it is concluded that this is a partial mediation model. The change in food insecurity accounts for 4% of the total effect of this model. Thus, when UO students' food security decreased (or food insecurity increased) from February 2020 to Fall 2020, fruit consumption also decreased from February 2020 to Fall 2020.



**Table 6**

*Change in Income as a Proposed Mediator for the Change in Eating Behaviors Among University of Oregon Students from February 2020 to Fall 2020 (n = 779)*

Model Name	$\beta$	SE	95% CI	<i>p</i>
<b>Fruit Consumption</b>				
Feb → Fall	0.69	.03	.63, .74	< .001
Feb → CI	- 0.10	.06	- .21, .01	.076
CI → Fall	0.09	.02	.05, .12	< .001
Feb → CI → Fall	- 0.01	.01	- .02, .01	> .05
<b>Vegetable Consumption</b>				
Feb → Fall	0.69	.03	.63, .74	< .001
Feb → CI	- 0.13	.05	- .24, - .03	.009
CI → Fall	0.06	.02	.03, .10	.001
Feb → CI → Fall	- 0.001	.001	- .02, - .01	< .05 <sup>†</sup>
<b>Whole Grain Consumption</b>				
Feb → Fall	0.71	.03	.65, .76	< .001
Feb → CI	- 0.05	.05	- .14, .05	.343
CI → Fall	0.01	.02	- .03, .05	.687
Feb → CI → Fall	- 0.001	.01	- .01, .01	> .05
<b>Protein Consumption</b>				
Feb → Fall	0.70	.03	.65, .75	< .001
Feb → CI	- 0.02	.07	- .15, .11	.779
CI → Fall	0.06	.01	.03, .08	< .001
Feb → CI → Fall	- 0.001	.01	- .01, .01	> .05

**Table 6 (continued)**

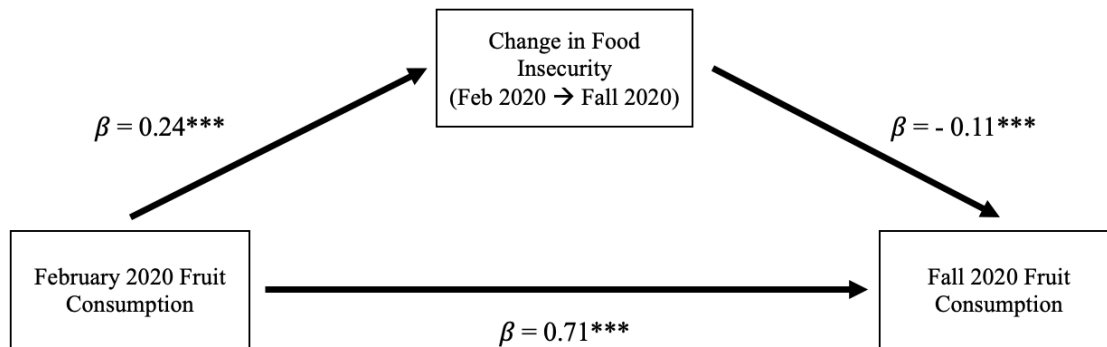
Model Name	$\beta$	SE	95% CI	<i>p</i>
<b>Water Consumption</b>				
Feb → Fall	0.82	.02	.78, .86	< .001
Feb → CI	- 0.03	.02	- .08, .02	.229
CI → Fall	0.01	.03	- .06, .06	.921
Feb → CI → Fall	- 0.0001	.001	- .003, .002	> .05
<b>Sugar Sweetened Beverage Consumption</b>				
Feb → Fall	0.68	.03	.63, .74	< .001
Feb → CI	0.03	.06	- .09, .14	.644
CI → Fall	0.01	.02	- .02, .05	.419
Feb → CI → Fall	0.0004	.002	- .002, .004	> .05
<b>Energy Drink Consumption</b>				
Feb → Fall	0.51	.02	.46, .55	< .001
Feb → CI	- 0.002	.01	- .03, .02	.889
CI → Fall	0.03	.07	- .10, .16	.648
Feb → CI → Fall	- 0.0001	.001	- .002, .002	> .05
<b>Restaurant Meal Consumption</b>				
Feb → Fall	0.51	.02	.46, .55	< .001
Feb → CI	0.004	.01	- .02, .03	.785
CI → Fall	0.02	.06	- .09, .14	.701
Feb → CI → Fall	0.0001	.002	- .004, .003	> .05

*Note.* Feb = February 2020 food or beverage consumption, Fall = Fall 2020 food or beverage consumption, CI = Change in Income, † = significant indirect effect. Due to

Hays mediation analyses in Process, significant  $p$  values ( $p < .05$ ) for the indirect (mediation) effect are from 5,000 bootstraps and do not provide exact  $p$  values.

#### Figure 4

*Change in Food Insecurity Did Mediate the Change in Fruit Consumption from February 2020 to Fall 2020 Among University of Oregon Students*



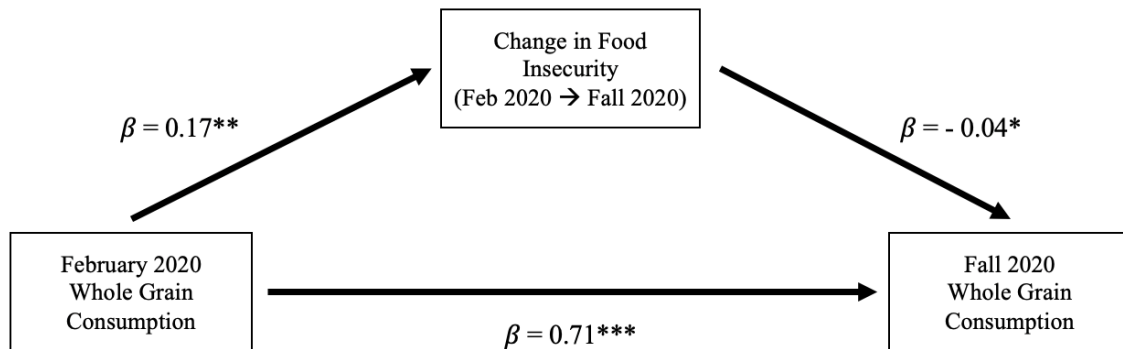
*Note.* \*\*\* =  $p < .001$ . A decrease in food security (or an increase in food insecurity) From February 2020 to Fall 2020 was associated with a decrease in fruit consumption from February 2020 to Fall 2020.

Figure 5 below shows that change in food insecurity did partially mediate the change in whole grain consumption between February 2020 ( $\beta = 0.17$ ,  $SE = .05$ , 95% CI [.06, .27],  $p < .01$ ), and Fall 2020 ( $\beta = -0.04$ ,  $SE = .02$ , 95% CI [-.07, -.01],  $p < .05$ ), when controlling for student status, international student status and race and ethnicity. These results indicate that the indirect effect of change in food insecurity was significant and negative ( $\beta = -0.01$ ,  $SE = .01$ , 95% CI [-.02, -.001]). The direct effect of February 2020 whole grain consumption on Fall 2020 whole grain consumption was significant and positive ( $\beta = 0.71$ ,  $SE = .03$ , 95% CI [.66, .76],  $p < .001$ ), and so was the total effect

of the model ( $\beta = 0.71$ ,  $SE = .03$ , 95% CI [.65, .78],  $p < .001$ ). Due to the fact that both the indirect and direct effects were significant, it is concluded that this is a partial mediation model. The change in food insecurity accounts for 1% of the total effect of this model. Thus, when UO students' food security decreased (or food insecurity increased) from February 2020 to Fall 2020, whole grain consumption also decreased from February 2020 to Fall 2020.

**Figure 5**

*Change in Food Insecurity from Did Mediate the Change in Whole Grain Consumption from February 2020 to Fall 2020 Among University of Oregon Students.*



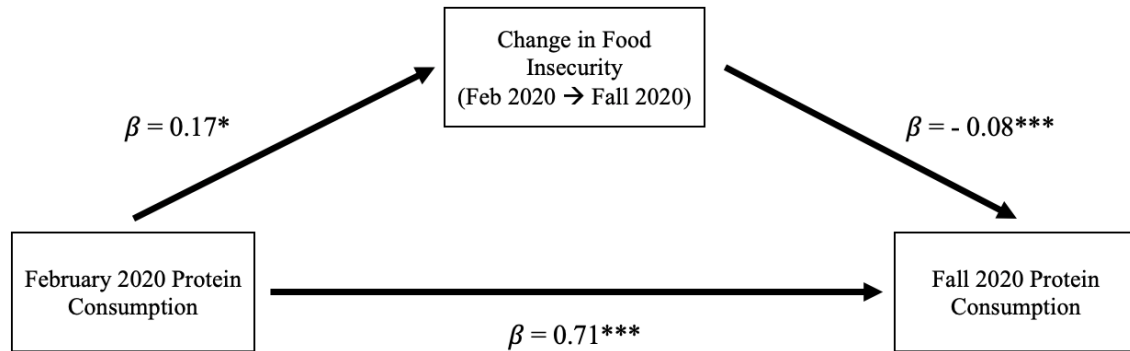
*Note.* \* =  $p < .05$ , \*\* =  $p < .01$ , \*\*\* =  $p < .001$ . A decrease in food security (or an increase in food insecurity) From February 2020 to Fall 2020 was associated with a decrease in whole grain consumption from February 2020 to Fall 2020.

Figure 6 below shows that change in food insecurity did mediate the change in protein consumption between February 2020 ( $\beta = 0.17$ ,  $SE = .07$ , 95% CI [.03, .32],  $p < .05$ ), and Fall 2020 ( $\beta = - 0.08$ ,  $SE = .01$ , 95% CI [-.11, -.06],  $p < .001$ ), when controlling for student status, international student status and race and ethnicity. These results

indicate that the indirect effect of change in food insecurity was significant and negative ( $\beta = -0.01$ ,  $SE = .01$ , 95% CI [-.03, -.001]). The direct effect of February 2020 protein consumption on Fall 2020 protein consumption was significant and positive ( $\beta = 0.71$ ,  $SE = .03$ , 95% CI [.66, .76],  $p < .001$ ), and so was the total effect of the model ( $\beta = 0.70$ ,  $SE = .03$ , 95% CI [.64, .75],  $p < .001$ ). Due to the fact that both the indirect and direct effects were significant, it is concluded that this is a partial mediation model. The change in food insecurity accounts for 2% of the total effect of this model. Change in food insecurity did not mediate the effect of February 2020 eating behaviors to Fall 2020 eating behaviors for all other foods and beverages including: vegetable, water, sugar sweetened beverages, energy drinks and restaurant meals, and are shown below in Table 7. Thus, when UO students' food security decreased (or food insecurity increased) from February 2020 to Fall 2020, protein consumption also decreased from February 2020 to Fall 2020.

**Figure 6**

*Change in Food Insecurity Did Mediate the Change in Protein Consumption from February 2020 to Fall 2020 Among University of Oregon Students.*



*Note.* \* =  $p < .05$ , \*\*\* =  $p < .001$ . A decrease in food security (or an increase in food insecurity) From February 2020 to Fall 2020 was associated with a decrease in protein consumption from February 2020 to Fall 2020.

**Table 7***Change in Food Insecurity as a Proposed Mediator for the Change in Eating**Behaviors Among University of Oregon Students from February 2020 to Fall 2020 (n = 779)*

Model Name	$\beta$	SE	95% CI	<i>p</i>
<b>Fruit Consumption</b>				
Feb → Fall	0.71	.03	.65, .76	< .001
Feb → CFS	0.24	.06	.12, .36	< .001
CFS → Fall	- 0.11	.02	- .14, - .08	< .001
Feb → CFS → Fall	- 0.03	.01	- .05, - .01	< .05 <sup>†</sup>
<b>Vegetable Consumption</b>				
Feb → Fall	0.69	.03	.64, .74	< .001
Feb → CFS	0.11	.06	- .001, .23	.051
CFS → Fall	- 0.12	.02	- .15, - .09	< .001
Feb → CFS → Fall	- 0.01	.01	- .03, .0004	> .05
<b>Whole Grain Consumption</b>				
Feb → Fall	0.71	.03	.66, .76	< .001
Feb → CFS	0.16	.05	.06, .27	.003
CFS → Fall	- 0.04	.02	- .07, - .01	.020
Feb → CFS → Fall	- 0.001	.004	- .02, - .0003	< .05 <sup>†</sup>

**Table 7 (continued)**

Model Name	$\beta$	SE	95% CI	<i>p</i>
<b>Protein Consumption</b>				
Feb → Fall	0.71	.03	.66, .76	< .001
Feb → CFS	0.17	.07	.03, .32	.019
CFS → Fall	- 0.08	.01	- .11, - .06	< .001
Feb → CFS → Fall	- 0.01	.01	- .03,- .002	< .05 <sup>†</sup>
<b>Water Consumption</b>				
Feb → Fall	0.82	.02	.78, .86	< .001
Feb → CFS	0.02	.03	- .03, .08	.396
CFS → Fall	- 0.01	.03	- .07, .04	.598
Feb → CFS → Fall	- 0.0003	.001	- .004, .002	> .05
<b>Sugar Sweetened Beverage Consumption</b>				
Feb → Fall	0.68	.03	.63, .73	< .001
Feb → CFS	- 0.11	.06	- .24, .01	.079
CFS → Fall	- 0.02	.01	- .05, .01	.141
Feb → CFS → Fall	0.003	.003	- .002, .009	> .05
<b>Energy Drink Consumption</b>				
Feb → Fall	0.51	.02	.46, .55	< .001
Feb → CFS	0.004	.01	- .02, .03	.785
CFS → Fall	0.02	.06	- .10, .14	.701
Feb → CFS → Fall	0.0001	.001	- .003, .003	> .05



**Table 7 (continued)**

Model Name	$\beta$	SE	95% CI	$p$
Restaurant Meal Consumption				
Feb → Fall	0.49	.03	.43, .56	< .001
Feb → CFS	0.07	.05	-.04, .17	.202
CFS → Fall	- 0.04	.02	-.09, -.002	.042
Feb → CFS → Fall	- 0.003	.004	-.01, .002	> .05

*Note.* Feb = February 2020 food or beverage consumption, Fall = Fall 2020 food or beverage consumption, CFS = Change in Food Security, † = indirect effect. Due to Hays mediation analyses in Process, significant  $p$  values ( $p < .05$ ) for the indirect (mediation) effect are from 5,000 bootstraps and do not provide exact  $p$  values.

## CHAPTER IV

### DISCUSSION

College students are a population at high risk for experiencing food insecurity (Payne-Sturges et al., 2018). The present study examined a) UO students' food security and eating behaviors changes from before the COVID-19 pandemic to during the COVID-19 pandemic b) how the potential changes in food security varied by student characteristics including: student status, international student status, race and ethnicity, and sexual orientation, c) if a change in income mediated the changes in pre-COVID-19 pandemic and during pandemic food security, and d) if change in food security or change in income mediated the changes in February 2020 to Fall 2020 eating behaviors. This study will contribute several novel findings to the literature, which will be discussed in more detail next. Importantly, these data will aid in the improvement and/or creation of programming that addresses food insecurity and unhealthy eating behaviors among college students most negatively impacted during the pandemic. Better addressing and preventing food insecurity and unhealthy eating behaviors among college students will lessen their risk for chronic diseases, and poor mental health and academic outcomes (CDC, 2020; Maroto et al., 2014; Pan et al., 2012; Wong et al., 2016).

This is the first study to the author's knowledge to show how the COVID-19 pandemic is associated with college students' food insecurity. The finding that college students did not experience any significant changes in their food insecurity from before to during the COVID-19 pandemic is inconsistent with the hypothesis in RQ1. When food insecurity was examined among students as a whole group, the proportion of students who were food insecure remained stable and high between February 2020, before the

pandemic (46.8%), and in Fall 2020, six to nine months into the pandemic (47.3%).

These proportions of UO students reporting food insecurity at both time points are higher than pre-pandemic college student food security literature which found that on average, 35-42% of students studied in the 17 peer-reviewed articles from around the world (nine of which were in the United States) reported food insecurity (Bruening et al., 2017; Payne-Sturges et al., 2018). An unpublished study by Kashuba in 2017 found that 52% of UO student survey respondents reported being food insecure (Kashuba, 2017). The present study found that reported food insecurity of UO students, with a comparable demographic breakdown to the sample from 2017, had lower food security in both February 2020 and Fall 2020. This reduction in food insecurity may be an indication that the investments and efforts the UO has made since 2017 (e.g. creating the Food Security Task Force and Food Pantry) have improved food security to a degree. The 2017 survey and this dissertation survey were performed at the same university, using similar measures to assess food insecurity, and students were recruited in similar ways via emails sent through different department and colleges on campus. The 2017 survey had a sample size of 1,236 while the survey for this dissertation had 779 total. It is important to note that comparing the differences in food insecurity since the implementation of food security programming is not possible due to the findings from this dissertation alone. During the COVID-19 pandemic, results from Texas Woman's University found that 34.5% of students reported being food insecure during the early months of the COVID-19 pandemic (Owens et al., 2020). Another study from six major, public research institutes across the United States found that 22% of undergraduate and 19% of graduate students surveyed were food insecure during the early months of the COVID-19 pandemic as well

(Soria et al., 2020). College students' reported food insecurity pre-COVID-19 pandemic and during the COVID-19 pandemic varies greatly around the United States, and UO students have reported higher rates of food insecurity during both of these times.

Importantly, the change in UO students' food insecurity during the COVID-19 pandemic was elucidated further when examined by student characteristics.

When examining the change in food security for different student characteristics, the data showed that food insecurity did indeed change significantly among some UO students. As hypothesized and novel to the literature, there was a significant increase in food insecurity from February 2020 to Fall 2020 for students who identified as sexual minorities, but no significant change for heterosexual students. This finding is consistent with pre-COVID-19 pandemic literature that showed that students who identify as sexual minorities have higher rates of food insecurity (Gates, 2014). One factor that may contribute to the significant increase in food insecurity for sexual minorities may be discrimination. Housing, employment and education discrimination based on having a minority sexual identity, may contribute to lower income and greater risk of food insecurity (Hasenbush et al., 2014). Healthy People 2020 identifies discrimination of all kinds as a social determinant of health (Healthy People, 2020). The Social Determinant of Health Framework outlines that Social Determinants of Health can interact to influence health in different ways (Healthy People 2030). Discrimination based on sexual identity may interact with food security to exacerbate poor eating behaviors and/or health, but such a hypothesis needs to be assessed. Housing status was not assessed in this survey. A report assessing housing affordability, discrimination and homelessness for LGBT people found that family rejection is a major reason why many have issues with

housing, and contributes to the high levels of homelessness amongst youth who identify as sexual minorities (Ecker, 2016; Romero, Goldberg & Vasquez, 2020). While other college students may have moved home with their families, this may have been less of an option among LGBTQIA+ students. Discrimination and a lack of familial support are some of the disparities that afflict LGBTQIA+ youth and young adults which may be contributing factors towards increased rates of food insecurity among this group (Gundersen et al., 2003; Haskett, Kotter-Grühn & Majumder, 2020). It is crucial to develop targeted food security programming and outreach efforts to reach students who identify as sexual minorities in order to address this disparity.

In contrast to the hypothesis for RQ2, food insecurity from February 2020 to Fall 2020 did not significantly change by student status, international student status, race or ethnicity. These findings are inconsistent with the recent literature assessing college students' food security during the COVID-19 pandemic, which found that undergraduate students, international students, and those who identified as Hispanic/Latinx and Asian have experienced significantly higher food insecurity during the pandemic compared to graduate, domestic and non-Hispanic White students (Soldavini, Andrew & Berner, 2021; Soria et al., 2020). These studies took place at Texas Woman's University, the University of California, Berkeley and the University of Minnesota where the demographic breakdown of students varied greatly (Owens et al., 2020; Soria et al., 2020). Makeup of the student bodies vary from that of the UO student body and the surrounding community. Specifically the study from the UO was predominantly non-Hispanic white (66.4%) and female (75.5%). International students were also highly underrepresented in the UO sample with only 3% of students identifying as international

students. These previously mentioned studies were also performed during the earlier months of the pandemic with data being collected in Spring and early Summer 2020. The data collected for this dissertation was in August to November 2020, about six to nine months into the pandemic which potentially could be capturing real differences in students' food security experiences later on in the pandemic compared to early on. These studies also assessed food insecurity using different measures than was used in this dissertation, took place during the early months of the COVID-19 pandemic (late spring-early summer 2020), did not ask students to recall pre-pandemic food insecurity and did not assess change in food insecurity over time (Owens et al., 2020; Soria et al., 2020). Results from this dissertation build on the literature by Owens and associates, Soldavini and associates and Soria and associates that shows that college students are a vulnerable population to food insecurity. The present study was cross-sectional, the survey asked students to report their food security during two time points.

Also contrary to the hypothesis, change in income did not mediate the change in food security between February 2020 and Fall 2020. These novel findings advance our understanding of the role of income in college students' food security change during the COVID-19 pandemic. These findings are not consistent with the pre-pandemic literature, which shows that changes in income are associated with changes in food security status (Coleman-Jensen et al., 2014). One factor for why the change in income did not mediate a change in food security was because the survey did not account for if students moved back home with family during the COVID-19 pandemic. The financial security of moving home with family and not having to rely on individual income could buffer the association of income loss and food security.

The hypothesis that college students' eating behaviors would change from February 2020 to Fall 2020 was not supported. Specifically, there were no significant changes in the consumption of healthy foods including, fruits and vegetables, whole grains and lean protein foods, and no significant changes in consumption of restaurant meals from a counter or drive-through, sugar sweetened beverages, and energy drinks from February 2020 to Fall 2020 when controlling for student status, international student status, and race and ethnicity. To the author's knowledge, this is the first study to have assessed college students' eating behaviors from before to during the COVID-19 pandemic. There are currently no studies that have assessed eating behaviors of college students over time, although these findings are contrary to the literature which state college students consume less healthy foods including fruits, vegetables and whole grains, and increased amounts of restaurant meals from a counter and sugar sweetened beverages (Oliver & Wardle, 1999; Cartwright et al., 2003). These findings show that there was no significant change in eating behaviors of UO students from February 2020 before the COVID-19 pandemic to Fall 2020 during the COVID-19 pandemic. Measuring eating behaviors via self-report and recalling information from six to nine months prior (February 2020) may not have been accurate. As previously stated, the survey for this dissertation did not assess if students moved home with family, which may have had an influence on the types and amounts of foods and beverages students consumed, or living situations in general did not have an influence on eating behaviors. A comparison of these data to pre-COVID-19 pandemic college student eating behaviors will help give a greater understanding as to the differences in eating behaviors, and if the eating behaviors during the COVID-19 pandemic were considered "normal".

Change in income and change in food security from February 2020 to Fall 2020 partially mediated corresponding changes in some eating behaviors and not others. Specifically, change in income partially mediated the change in vegetable consumption from February 2020 to Fall 2020 such when income decreased from February 2020 to Fall 2020, vegetable consumption also decreased from February 2020 to Fall 2020. Change in income did not mediate the change in consumption for any other food or beverage category. Change in food security mediated fruit, whole grain, and protein consumption from February 2020 to Fall 2020, such when food security decreased (or food insecurity increased) from February 2020 to Fall 2020, fruit, whole grain and protein intake also decreased from February 2020 to Fall 2020. Change in food security did not mediate the change in consumption for any other food or beverage category. Thus, decreased income and increased food security were associated with the quantity and types of some foods and beverages consumed for this sample of UO students. These findings begin filling the gaps in the literature assessing how factors including income and food security may influence eating behaviors of college students over time (Oliver & Wardle, 1999; Cartwright et al., 2003). These findings will be helpful to both UO and college administrators and will inform and guide programs and food services aimed to help students have access to healthy foods. Results indicate that fruits, vegetables, whole grains and protein foods are particularly important foods to highlight availability at food pantries and to have at lower price points at vendors on campus to aid students in purchasing to improve intake.

UO students' eating behaviors did not meet current dietary guidelines for all food groups in February 2020 or Fall 2020 (Dietary Guidelines for Americans, 2020). On



average, students consumed well below the daily recommended servings for fruits, vegetables, whole grains, protein foods and water both in February 2020 and Fall 2020 (Dietary Guidelines for Americans, 2020). These results are helpful in that it gives us a perspective as to how many servings of certain foods and beverages including fruit, vegetable, whole grains, and protein foods college students' are consuming on an average, daily basis. Although, this survey did not ask students about other eating behaviors including a more in-depth assessment of the types and quantities of all foods and beverages consumed on an average, daily basis during the COVID-19 pandemic. Results will inform college foodservice about foods to highlight (in this case, fruits, vegetables, proteins and whole grains) and inform price reductions on these foods to improve consumption. As colleges and universities begin to open up safely, public health campaigns geared towards encouraging students to drink more water and consume fruits, vegetables, whole grains and protein foods may help create healthy behavior changes. Although these survey questions are valid and reliable measures of large scale eating behaviors, they only give a small window to what college students' consume on a daily basis. As previously stated, self-report eating behaviors, especially recalling eating behaviors six to nine months prior like in this survey may not have yielded valid responses from participants. These results will add to the literature about college students' eating behaviors, and will begin the literature assessing college student eating behavior change over time.

It is important to note that colleges and universities around the United States are realizing that food insecurity is a problem for their students, and many have begun implementing programs to address this issue. Programs including free food pantries,

produce drops, and helping students sign up for SNAP provide students with access to free food. The hope for food pantries is that they will reduce short-term food insecurity by providing students with nutritious, free foods. According to the USDA, the Consolidated Appropriations Act, which went into place on January 16, 2021 is temporarily allowing more college students to enroll and receive SNAP benefits through the entirety of the COVID-19 pandemic, which in turn will allow them to purchase healthy foods that they may not have been able to afford otherwise (USDA, 2021). Other programming aimed towards helping students who are food insecure vary from campus to campus, and there are no studies that assess changes in academic outcomes due to participation. There are also no studies that assess food security after graduation, thus future studies should begin to assess post-graduation food security.

In response to the high proportion of UO students who reported food insecurity, the UO administration created the Food Security Task Force in 2018 and implemented several programs including the Student Food Pantry, Ducks Feeding Ducks, and the Produce Drop to help improve students' access to healthy foods. The Food Security Task Force's mission is to ensure that all UO students, but particularly students from historically marginalized and underserved populations, have access to adequate amounts of nutritious and culturally appropriate food. This dissertation is the only follow up data to the 2017 study previously mentioned.

Colleges and universities care about their students' academic performance, graduation rates, and average time it takes their students to graduate. They track this information and invest time, effort and money towards supporting students and improving these metrics (Martinez et al., 2020). These measures are important to colleges

and universities because successful students and high graduation rates entice future students who want to be successful to their institution to become successful (Smyth & McArdle, 2004). These measures also have an effect on the way higher education institutes are ranked, and are a factor for most when choosing schools to apply and attend (Monks & Ehrenberg, 1999). More and more colleges are demonstrating their concern about the health and academic performance of their students, by investing in programs to support their food security (Davis, Sisson & Clifton, 2020).

Future directions and interventions aimed to aid in the improvement in college students' food security and eating behaviors are necessary. The next steps, specifically at the University of Oregon would be to conduct sessions with students, including individual interviews, focus groups and mass surveys. Important topics to ask students include: barriers to accessing healthy foods, ways to improve food security programming at the university, programs they would like to see, cultural appropriateness and responsiveness of food security programming, and the types of foods they would purchase if available on campus. This information will help administrators create and implement appropriate programming that students want to see. Currently, there are no studies that have assessed food insecurity longitudinally for college students after graduation, assessing if food insecurity continues to be a chronic issue. Future studies should be conducted longitudinally following college students and assessing food insecurity over a long period of time during college and post-graduation to assess if and how food security status has changed over time.

## **Strengths and Limitations**

A first strength to this study is that this is the first study to this author's knowledge that has combined assessing both change in food security and eating behaviors for college students from before the COVID-19 pandemic to during the COVID-19 pandemic in one study. Most questions in this study that assessed food and beverage intake including fruit, vegetable, whole grain, sugar sweetened beverages and energy drinks derived from valid and reliable tools (NCHA, NHANES), while protein, water and restaurant meal consumption questions were created by the researcher in the same style (ACHA, 2013; NHANES, 2020). A third strength to this study is that the survey tool created for this dissertation has become well known, and versions of this survey are currently in use at two California State University campuses in the Spring 2021 term to assess food security and eating behavior change from before the COVID-19 pandemic to during the COVID-19 pandemic. Combining findings from this dissertation and data from the collaboration with the two California State University institutions will provide valuable insight into food security and eating behavior changes from before the COVID-19 pandemic to during the COVID-19 pandemic of different samples of students at different universities. These multiple data sets will allow for a more in depth analysis of these variables with more generalizable findings. A fourth strength to this study is that students were incentivized to participate in the survey by being told that if they completed at least 80% of the survey they would be entered to gift card drawings. A post assessment of participation showed that one in eleven students who completed at least 80% of the survey won one of the 65, \$20 Safeway e-gift cards. A fifth strength to this study is the sample of students who participated. UO students who participated in this

study predominantly identified as female (75.5%), White (66.4%) and domestic (97.0%), and nearly one-third (31.3%) of students surveyed identified as part of the LGBTQIA+ community.

A sixth strength to this study is that it will provide information about UO students' food security and eating behaviors before and during the COVID-19 pandemic that has not been performed yet. Since the study performed by Kiara Kashuba in 2017, there have been no formal assessments of UO students' food security. There have also been no assessments of UO students' eating behaviors on a large scale such as the survey from this dissertation. These valuable data will be presented to UO administration including President Michael Schill, the Associated Students of the University of Oregon (ASUO), UO risk management and other UO administrators, to inform additional investments, policies, and efforts, and improve established programming aimed to support students' food security during a pandemic. The UO and similar institutions will be able to use these data, and the data collected using the same tool at the two California State Universities to implement changes to help students improve food security and consume healthy foods. In the long run, addressing food insecurity may improve the health and academic performance of students, and will reduce the financial burden of struggling to afford healthy food while on a student budget.

Importantly, this is a cross sectional study, which means that causal inferences cannot be made, despite asking respondents to report on two different time periods. Even though mediation is assessed and indirect and direct effects are reported, these are associations and not causal pathways. Results of this study could be influenced by selection bias. The sample of UO students had similarities and differences to the UO

student body. The latest UO student demographic data collected in Fall 2019 showed that 53.7% of the UO student body identify as female, 60% non-Hispanic White and 10.0% international (UO Division of Equity and Inclusion, 2021). This shows that these data reflect the experiences of a specific group of students who predominantly identify as female, non-Hispanic White and domestic students, which is not representative of the UO population. This overrepresentation of female, non-Hispanic White and domestic students may have also skewed the results because female, non-Hispanic White and domestic students often report less food insecurity and healthier eating behaviors (Almohanna et al., 2015; Abraham et al., 2018; Befort et al., 2006; Gaines et al., 2014). The UO does not have any statistics on student identified sexual orientation, thus a comparison of survey sexual orientation cannot be compared.

Another example of potential selection bias is that students who were most affected by the COVID-19 pandemic may have experienced reduced capacity and may not have been able to complete the survey, thus, potentially, underrepresenting food insecurity in the results. Alternatively, those experiencing food insecurity may have been more motivated to take a survey about food insecurity, potentially overrepresenting the problem in the results. The cross-sectional nature of this study means that the most accurate assessment of change in income, food security, and eating behaviors were not possible. Importantly, respondents had to recall information from February 2020, which was six to nine months prior to data collection in Fall 2020. This introduces recall bias, which would make these results less trustworthy regarding accuracy of measurement than a true longitudinal study. Income measurement in the survey did not account for all income each student had, or how much money each student had access to. An exact, clear

view of students' financial status, which may have been associated (or not) with their food security or eating behaviors was not assessed. The survey was also open from late August to November 2020, an unprecedented time with students not physically present and participating in school virtually due to COVID-19 regulations, which may have caused students to have computer and screen fatigue, thus not participating in extra computer activities such as this online-based survey.

## **Conclusion**

UO students continued to experience food insecurity at high rates of food insecurity in February 2020 and six to eight months into the COVID-19 pandemic and statewide stay-at-home order. When examined as a whole, UO students' did not have significant changes in food security and eating behaviors from before to during the pandemic. Nor did change in income mediate change in food security. However, when examined by student characteristics, those who identified as sexual minorities had a significant increase in food insecurity, where heterosexual students did not. Change in food security mattered more than change in income in explaining changes in eating behaviors; such that decreases in food security (or increases in food insecurity mediated decreases in some eating behaviors. Findings from this study provide UO administrators and administrators at other, similar universities a clearer understanding of college students' food security and eating behaviors before and during the COVID-19 pandemic. These data can inform new or existing programming and policies that aim to prevent and address food insecurity and promote healthy eating among college students. Better addressing food insecurity and unhealthy eating among college students should lessen

their risk for chronic diseases and improve their academic performance (Cady, 2014; Moore et al., 2009).



## APPENDIX A

University of Oregon Student Food Security and Accessibility COVID-19 Survey

**Page 1**

**University of Oregon**  
**Informed Consent for Participation as a Subject in**  
University of Oregon Student Food Security and Accessibility COVID-19 Survey  
**Investigator:** Anna Cahn, MS, RDN

**Introduction:**

You are being asked to participate in a research study which is supported by the University of Oregon's Food Security Task Force and Food Studies Program and is being conducted by University of Oregon Prevention Science Doctoral Student, Anna Cahn.

**Purpose of the Study:**

The purpose of this research is to assess how the COVID-19 pandemic and stay-at-home order has affected University of Oregon students food security (access to affordable, healthy foods), eating behaviors and grocery store habits.

**Description of the Study Procedures:**

Your participation in this study is voluntary and will include completing a 10-15 minute survey. You can skip any question you are uncomfortable answering or stop participating at any time, but you must complete 80% of the survey in order to be eligible for the gift card drawings.

After completing the survey and providing your UO email address (@uoregon.edu), you will be entered into drawings for up to one of 65 \$20 Safeway gift cards for your participation. Your survey answers will be kept confidential and your name and email address will not be attached to the answers you provide in the survey.

The researcher conducting this study is Anna Cahn, Principal Investigator and Dr. Liz Budd, Faculty Advisor. For questions or more information concerning this research you may contact [acahn@uoregon.edu](mailto:acahn@uoregon.edu).

**For questions about your rights as a research participant you may contact:**

Research Compliance Services, University of Oregon at (541) 346-2510 or [ResearchCompliance@uoregon.edu](mailto:ResearchCompliance@uoregon.edu)

**Statement of Consent:**

To continue, please indicate your consent to participate in this study below:

- I have read the consent information and I consent to participate in this study (1)
- I do not consent to be a part of this study (2)

## Page 2

### Eligibility Questions

Q1. Are you a current University of Oregon student?

- Yes (1)
- No (0)

Q2. Are you 18 years of age or older?

- Yes (1)
- No (0)

- If respondents choose No for either question of Page 2, they will see the following statement and will not be able to continue on to take the survey.
  - Thank you for your interest in this study. Unfortunately, you do not qualify to participate.

## Page 3

### Demographic Questions

Q3. What is your age

- drop down menu with ages 18-90 years old (continuous)

Q4. What is your gender identity (e.g., male, female, transmasculine, transfeminine, gender-nonbinary, agender)? [write in box] (please specify) (write in)

1 = male

2 = female

3 = nonbinary

4 = transgender male

5 = transgender female

6 = agender

Q5. Do you consider yourself to be Hispanic or Latino?

- No, not Hispanic, Latino, or Latinx (0)
- Yes, Hispanic, Latino, or Latinx (1)

Q6. Which of the following races/ethnicities do you consider yourself? (Check all that apply) (MULTIPLE)

- White/European American (1)
- Black or African American (2)
- Native American/American Indian or Alaska Native (3)
- Asian or Asian American (4)
- Native Hawaiian or other Pacific Islander (5)
- Other (please specify) (6) and WRITE IN
- Multiracial (7)

Q7. What is your sexual orientation?

- Heterosexual (1)
- Bisexual (2)
- Pansexual (3)
- Lesbian (4)
- Gay (5)
- Queer (6)
- Asexual (7)
- Other (please specify) (8) and WRITE IN

Q8. Do you have at least one child or other dependent (e.g., sick or elderly parent) who relies on you for care?

- Yes (1)
- No (0)

Q9. What is your current student status at the University of Oregon?

- Undergraduate- Freshman (0-44 credits) (1)
- Undergraduate- Sophomore (45-89 credits) (2)
- Undergraduate- Junior (90-134 credits) (3)
- Undergraduate- Senior (135 credits or more) (4)
- Graduate- Masters level (5)
- Graduate- Doctoral level (6)
- Graduate- Certificate Program (7)
- Law student (8)
- Other (please specify) (9) and write in

Q10. Are you an international student?

- Yes (1)
- No (0)

**Page 4**

**On March 23, 2020, Oregon Governor Kate Brown issued a statewide “Stay Home, Save Lives” order, which closed non-essential businesses like gyms, hair salons and in-person dining (still allowing takeout). This order asked Oregonians to limit the amount of time they spent in public places to help slow the spread of COVID-19.**

Q11. Think back to February 2020 **before** the stay-at-home/shelter in place order, approximately how many hours per week did you work for pay?

- Drop down menu 0-70 hours (continuous)

Q12. Think back to February 2020 **before** the stay-at-home/shelter in place order, approximately how much was your monthly individual income?

- No income (0)
- Less than \$500.00 (1)
- \$500.00 to \$999 (2)
- \$1,000 to \$1,499 (3)
- \$1,500 to \$1,999 (4)
- \$2,000 to \$2,499 (5)
- \$2,500 to \$2,999 (6)
- \$3,000 to \$3,499 (7)
- \$3,500 to \$3,999 (8)
- \$4,000 to \$4,499 (9)
- \$4,500 to \$4,999 (10)
- \$5,000 or more (11)

Q13. Think back to February 2020 **before** the stay-at-home/shelter in place order, did you receive financial support from another household member or family member?

- Yes (1)
- No (0)

Q14. Think back to February 2020 **before** the stay-at-home/shelter in place order, where were you living?

- On the UO Campus (for example: in a dorm on campus) (1)
- Off-campus, in or around the greater Eugene-Springfield area (2)
- More than 20 miles away from the greater Eugene-Springfield area, but within Oregon (3)
- Outside of Oregon (4)

Q15. **Currently**, approximately how many hours per week do you work for pay?

- Drop down 0-70 hours continuous

Q16. **Currently**, approximately how much is your monthly individual income?

- No income (0)
- Less than \$500.00 (1)
- \$500.00 to \$999 (2)
- \$1,000 to \$1,499 (3)
- \$1,500 to \$1,999 (4)
- \$2,000 to \$2,499 (5)
- \$2,500 to \$2,999 (6)
- \$3,000 to \$3,499 (7)
- \$3,500 to \$3,999 (8)
- \$4,000 to \$4,499 (9)
- \$4,500 to \$4,999 (10)
- \$5,000 or more (11)

**Q17. Currently**, do you receive financial support from another household member or family member?

- Yes (1)
- No (0)

**Q18. Currently**, where are you living?

- On the UO Campus (for example: in a dorm on campus) (1)
- Off-campus, in or around the greater Eugene-Springfield area (2)
- More than 20 miles away from the greater Eugene-Springfield area, but within Oregon (3)
- Outside of Oregon (4)

## Page 5

Food Security before the Stay-at-home Order

Please select responses to the following 8 items that best match your experience **during the month of February 2020 BEFORE** the stay-at-home/shelter in place order.

Q19. The food that I bought just didn't last, and I didn't have money to get more.

- Often true (1)
- Sometimes true (1)
- Never true (0)

Q20. I couldn't afford to eat balanced meals.

- Often true (1)
- Sometimes true (1)
- Never true (0)

Q21. Did you ever cut the size of your meals or skip meals because there wasn't enough money for food?

- Yes, almost every day (2)
- Yes, some days, but not every day (2)
- Only 1 or 2 days a month (2)
- No (0)

Q22. Did you ever eat less than you felt you should because there wasn't enough money for food?

- Yes (1)
- No (0)

Q23. Were you ever hungry but didn't eat because there wasn't enough money for food?

- Yes (1)
- No (0)

Q24. Did you or any member of your household use food assistance programs like SNAP/food stamps or WIC ? (this does not include roommates)

- Yes (1)
- No (0)

Q25. Did you or any member of your household ever get emergency food from a church, a food pantry, food bank, or eat in a soup kitchen?

- Yes (1)
- No (0)

Q26. Did you ever use any of the food assistance programs available at the UO?

Programs include: Student Food Pantry, Ducks feeding Ducks, Produce Drop.

- Yes-regularly (3)
- Yes- only sometimes (2)
- No-but I've heard of them (1)
- No- I've never heard of them (0)

## Page 6

### Food Security Currently

Please select responses to the following 8 items that best match your experience **in the past month.**

Q27. The food that I buy just doesn't last, and I don't have money to get more.

- Often true (1)
- Sometimes true (1)
- Never true (0)

Q28. I can't afford to eat balanced meals.

- Often true (1)
- Sometimes true (1)
- Never true (0)

Q29. Do you ever cut the size of your meals or skip meals because there isn't enough money for food?

- Yes, almost every day (2)
- Yes, some days, but not every day (2)
- Only 1 or 2 days a month (2)
- No (0)

Q30. Do you ever eat less than you feel you should because there isn't enough money for food?

- Yes (1)
- No (0)

Q31. Are you ever hungry but don't eat because there isn't enough money for food?

- Yes (1)
- No (0)

Q32. Do you or any member of your household use food assistance programs like SNAP/food stamps or WIC? (this does not include roommates)

- Yes (1)
- No (0)

Q33. Do you or any member of your household ever get emergency food from a church, a food pantry or a food bank, or eat in a soup kitchen?

- Yes (1)
- No (0)

Q34. Do you use any of the food assistance programs available at the UO? Examples include: Student Food Pantry, Ducks feeding Ducks, and Produce Drop.

- Yes-regularly (3)
- Yes- only sometimes (2)
- No-but I've heard of them (1)
- No- I've never heard of them (0)

## Page 7

### Eating & Grocery Shopping Behaviors before the Stay-at-home Order

Please select responses to the following 11 questions that best match your typical behaviors **during the month of February 2020 BEFORE** the stay-at-home/shelter in place order.

Q35. How many servings of fruit did you eat on average per day? One serving is a medium piece of fresh fruit; ½ cup of fresh, frozen or canned fruit; ¼ cup of dried fruit; or ¾ cup of 100% fresh fruit juice

- Drop down with numbers- 0 servings per day then drop down to 6 or more (max) 0 servings per day, 1,2,3,4,5, 6 or more servings per day (0-6)

Q36. How many servings of vegetables did you eat on average per day? One serving is ½ cup of fresh, frozen or canned vegetables, ¾ cup 100% vegetable juice; or 1 cup salad greens.

- Drop down with numbers- 0 servings per day then drop down to 6 or more (max) 0 servings per day, 1,2,3,4,5, 6 or more servings per day (0-6)

Q37. How many servings of whole grain products did you eat on average per day? One serving is one slice of whole grain or whole wheat bread, ½ cup oatmeal, 1/3 cup brown rice, ½ cup whole wheat pasta, **do not** include regular pasta or white bread.

- Drop down with numbers- 0 servings per day then drop down to 6 or more (max) 0 servings per day, 1,2,3,4,5, 6 or more servings per day (0-6)

Q38. How many servings of protein foods did you eat on average per day? One serving is 3 oz (or the size and thickness of a smartphone or deck of cards) of chicken, beef, fish or pork, 2 whole eggs, 1/3 cup cooked beans or lentils, or 4 oz tofu

- Drop down with numbers- 0 servings per day then drop down to 4 or more (max) 0 servings per day, 1,2,3,4 or more servings per day (0-4)

QPayAttent. Please select answer choice B to indicate you are paying attention

- A (0)
- B (1)
- C (0)

Q39. How many total cups of plain water did you drink on average per day? Plain water includes plain tap water, water from a drinking fountain, water from a water cooler, bottled water and spring water. One serving is 8 oz or 1 cup of fluid water. (drop down of cups of water)

- Drop down with numbers- 0 servings per day then drop down to 9 or more (max) 0 servings per day, 1,2,3,4,5, 6, 7, 8, 9 or more servings per day (0-9)

Q40. How many servings of sugar sweetened beverages did you drink on average per day? One serving is 12 oz of soda; 8 oz of sugar-sweetened, flavored water or sports drink; 6 oz of sugar-sweetened coffee, tea, or juice.

- Drop down with numbers- 0 servings per day then drop down to 6 or more (max) 0 servings per day, 1,2,3,4,5, 6 or more servings per day (0-6)

Q41. In the month of **February 2020**, how many days did you drink energy drinks or energy shots (for example: Red Bull, Monster, Full Throttle, 5 Hour Energy, Rockstar Energy Shot, or Full Throttle Energy Shot, etc.)

- (drop down with 0-29) 0 days, 1,2,3,4,... 29 days (0-29)

Q42. In the month of **February 2020**, how many times did you buy food at a restaurant where food is ordered at a counter or at a drive-through window (there is no waiter/waitress)?

- Never or rarely (0)
- 1 time per month (1)
- 2-3 times per month (2)
- 1-2 times per week (3)
- 3-4 times per week (4)
- 5-6 times per week (5)
- 1 time per day (6)
- 2 times per day (7)
- 3 or more times per day (8)



Q43. In the month of **February 2020 before the stay-at-home order**, where did you get the majority of your groceries?

- Supermarket or grocery store (like Safeway, Trader Joes, WinCo, Whole Foods) (1)
- Supercenter (like Target, Walmart or Fred Meyer) (2)
- Bulk warehouse store (like Costco, or Smart Foodservice Warehouse Store) (3)
- Convenience store or liquor store (Dari Mart, 7-11) (4)
- Online grocery delivery service (5)
- Food bank or Food Pantry (6)
- Other (please specify) (7) and write in

Q44. In the month of **February 2020 before the stay-at-home order**, how did you get the majority of your groceries?

- I went to a store (1)
- A family member or friend went to a store for me (2)
- I ordered them online (like Amazon, Boxed, Fresh Direct, Thrive Market) (3)
- I ordered them through a grocery delivery service (like Instacart, Fred Meyer Delivery, Safeway Delivery) (4)
- Other (please specify) (5)

Q45. In the month of **February 2020 before the stay-at-home order**, how many days did you go shopping for groceries?

- Drop down- 0 days 1, 2, 3,... 29 days (0-29)

## **Page 8**

### Eating & Grocery Shopping Behaviors Currently

Please select responses to the following 11 questions that best match your typical behaviors **CURRENTLY**.

Q46. How many servings of fruit do you eat on average per day? One serving is a medium piece of fresh fruit; ½ cup of fresh, frozen or canned fruit; ¼ cup of dried fruit; or ¾ cup of 100% fresh fruit juice

- Drop down with numbers- 0 servings per day then drop down to 6 or more (max) 0 servings per day, 1,2,3,4,5, 6 or more servings per day (0-6)

Q47. How many servings of vegetables do you eat on average per day? One serving is ½ cup of fresh, frozen or canned vegetables, ¾ cup 100% vegetable juice; or 1 cup salad greens.

- Drop down with numbers- 0 servings per day then drop down to 6 or more (max) 0 servings per day, 1,2,3,4,5, 6 or more servings per day (0-6)

Q48. How many servings of whole grain products do you eat on average per day? One serving is one slice of whole grain or whole wheat bread, ½ cup oatmeal, 1/3 cup brown rice, ½ cup whole wheat pasta, **do not** include regular pasta or white bread.

- Drop down with numbers- 0 servings per day then drop down to 6 or more (max) 0 servings per day, 1,2,3,4,5, 6 or more servings per day (0-6)

Q49. How many servings of protein foods do you eat on average per day? One serving is 3 oz (or the size and thickness of a smartphone or deck of cards) of chicken, beef, fish or pork, 2 whole eggs, 1/3 cup cooked beans or lentils, or 4 oz tofu

- Drop down with numbers- 0 servings per day then drop down to 4 or more (max) 0 servings per day, 1,2,3,4 or more servings per day (0-4)

Q50. How many total cups of plain water do you drink on average per day? Plain water includes plain tap water, water from a drinking fountain, water from a water cooler, bottled water and spring water. One serving is 8 oz or 1 cup of fluid water. (drop down of cups of water)

- Drop down with numbers- 0 servings per day then drop down to 9 or more (max) 0 servings per day, 1,2,3,4,5, 6, 7, 8, 9 or more servings per day (0-9)

Q51. How many servings of sugar sweetened beverages do you drink on average per day? One serving is 12 oz of soda; 8 oz of sugar-sweetened, flavored water or sports drink; 6 oz of sugar-sweetened coffee, tea, or juice.

- Drop down with numbers- 0 servings per day then drop down to 6 or more (max) 0 servings per day, 1,2,3,4,5, 6 or more servings per day (0-6)

**Q52. In the past month**, how many days did you drink energy drinks or energy shots (for example: Red Bull, Monster, Full Throttle, 5 Hour Energy, Rockstar Energy Shot, or Full Throttle Energy Shot, etc.)

- (drop down with 0-30) 0 days, 1,2,3,4,.... 30 days (0-30)

**Q53. In the past month**, how many times did you buy food at a restaurant where food is ordered at a counter or at a drive-through window (there is no waiter/waitress)?

- Never or rarely (0)
- 1 time per month (1)
- 2-3 times per month (2)
- 1-2 times per week (3)
- 3-4 times per week (4)
- 5-6 times per week (5)
- 1 time per day (6)
- 2 times per day (7)
- 3 or more times per day (8)

**Q54. In the past month**, where did you get the majority of your groceries?

- Supermarket or grocery store (like Safeway, Trader Joes, WinCo, Whole Foods) (1)
- Supercenter (like Target, Walmart or Fred Meyer) (2)
- Bulk warehouse store (like Costco, or Smart Foodservice Warehouse Store) (3)
- Convenience store or liquor store (Dari Mart, 7-11) (4)
- Online grocery delivery service (5)
- Food bank or Food Pantry (6)
- Other (please specify) (7) and write in

**Q55. In the past month**, how did you get the majority of your groceries?

- I went to a store (1)
- A family member or friend went to a store for me (2)
- I ordered them online (like Amazon, Boxed, Fresh Direct, Thrive Market) (3)
- I ordered them through a grocery delivery service (like Instacart, Fred Meyer Delivery, Safeway Delivery) (4)
- Other (please specify) (5)

**Q56. In the past month**, how many days did you go shopping for grocery items including food and drinks per month?

- Drop down- 0 days 1, 2, 3,... 31, more than 31 days (0-31)

### Page 9

- Thank you for your participation in this survey, and for sharing your experiences!
- Be sure to press submit to complete your survey. After pressing submit, you will be brought to a page where you can give us your UO email address to be entered in a drawing for one of 65 \$20 Safeway gift cards.
- (submit to separate Qualtrics below to collect contact information)

### New survey

If you would like to be entered into drawings to receive one of 65 \$20 Safeway gift cards, please provide your name and UO email address below. Only students who complete at least 80% of the survey and share a valid University of Oregon email address will be eligible to receive a gift card. If you are selected in one of the drawings to receive a gift card, you will receive the gift card via email.

**PLEASE NOTE:** Your name and email address will not be associated with any of the survey responses. Your information will be kept confidential.

**Enter Name:** (write in for full name)

**Your @uoregon.edu email address:** (write in for email address)

Please select the submit button to be finished.  
**(will press submit again)**

**Page 10**

Thank you, your response has been recorded.

APPENDIX B

*Food Security Responses for University of Oregon Students in February 2020 and Fall*

2020 (n = 779)

	February 2020	Fall 2020
	n (%)	
The food that I bought just didn't last, and I didn't have money to get more.		
Often true	41 (5.3)	74 (9.5)
Sometimes true	194 (24.9)	220 (28.2)
Never true	543 (69.7)	485 (62.3)
Missing	1	0
I couldn't afford to eat balanced meals.		
Often true	89 (11.4)	106 (13.6)
Sometimes true	215 (27.6)	236 (30.3)
Never true	475 (61.0)	437 (56.1)
Missing	0	0
Did you ever cut the size of your meals or skip meals because there wasn't enough money for food?		
Yes, almost every day	28 (3.6)	49 (6.3)
Yes, some days, but not every day	140 (18.0)	148 (19.0)
Only one or two days a month	166 (21.3)	141 (18.1)
No	445 (57.1)	441 (56.6)
Missing	0	0
Did you ever eat less than you felt you should because there wasn't enough money for food?		
Yes	247 (31.7)	255 (32.7)
No	532 (68.3)	524 (67.3)
Missing	0	0
Were you ever hungry but didn't eat because there wasn't enough money for food?		
Yes	160 (20.5)	178 (22.8)
No	619 (79.5)	601 (77.2)
Missing	0	0
Receives Food Assistance (e.g. Supplemental Nutrition Assistance Program)		
Yes	135 (17.3)	156 (20.0)
No	644 (82.7)	623 (80.0)
Missing	0	0

**Appendix B (continued)**

	February 2020	Fall 2020
	<i>n (%)</i>	
Use of Emergency Food (e.g. food pantry, food bank)		
Yes	127 (16.3)	119 (15.3)
No	652 (83.7)	660 (84.7)
Missing	0	0
Use of UO Food Assistance Programming (e.g. Student Food Pantry, Ducks Feeding Ducks, Produce Drop)		
Yes-regularly	41 (5.3)	30 (3.9)
Yes-only sometimes	145 (18.6)	85 (10.9)
No-but I've heard of them	394 (50.6)	506 (65.0)
No-I've never heard of them	199 (25.5)	158 (20.3)
Missing	0	0

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