INFLUENCE OF COVID-19 ON FOOD INSECURITY AMONG COLLEGE STUDENTS DURING AND AFTER CAMPUS SHUTDOWN

by

JACEY LEONARD

(Under the Direction of Alex Anderson)

ABSTRACT

Food insecurity is one of the United States largest public health and nutrition issues, with college students being disproportionately affected. Paralleled with the onset of the COVID-19 pandemic in March 2020, food insecurity rates doubled among college students. This cross-sectional study examined the burden and determinants of food insecurity among college students during and after campus shutdown due to the COVID-19 pandemic. Methods include a self-report, online survey hosted on the "Qualtrics" platform. The link to the survey was sent via email to all spring 2022 enrolled undergraduate and graduate students at UGA. The findings show that food insecurity increased, overall dietary diversity improved, physical activity and structured workouts increased, and a higher number of participants received emergency funding after campus shut down compared to during shut down. These results provide useful insights for universities and other governing bodies on ways to combat food insecurity on college campuses.

INDEX WORDS: Food insecurity, college students, dietary diversity, physical activity, COVID-19 pandemic

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DEDICATION

To my parents, who always encourage me to keep going.

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CHAPTER ONE

INTRODUCTION

Food insecurity is defined as a state where "the availability of nutritionally adequate and safe foods or the ability to acquire acceptable foods in socially acceptable ways is limited or uncertain" (Anderson, 1990). In the United States, 11.8% of households are food insecure as of 2022 (USDA, 2022). The incidence of food insecurity was considerably higher than the national average among single parent, and Black and Hispanic households (USDA Economic Research Service, 2020).

1.1 Impacts of Food Insecurity

The experience of food insecurity is often accompanied by a myriad of physiological and psychological issues, including worsened physical and mental health status. Although seemingly unlikely, food insecurity is often associated with obesity (Dinour, 2007). A 2007 systematic review by Dinour and colleagues highlights a direct correlation between self-reported food insecurity and obesity (BMI of 30 or greater) from an analysis of the NHANES III data (Dinour, 2007). Along with obesity, many other chronic disease states are more prevalent among food insecure populations, including type II diabetes and certain cancers (Thomas, 2021). Although negative physical health outcomes related to food insecurity are often highlighted, mental health issues can be just as common and debilitating. Increased rate of depression, anxiety, shame, chronic stress, lack of concentration and worry about where their next meal will come from are commonly seen in food insecure households (Hawkins, 2021). A 2020 study by Afulani and colleagues reveal a progressive relationship between food insecurity and severe mental illness,

with the severity of food insecurity experienced increasing with the incidence of severe mental illness (Afulani, 2020). Low socioeconomic populations are at a higher risk of these negative health outcomes due to the increased prevalence of food insecurity among these populations (Gundersen & Ziliak, 2015; Maia et al., 2019).

1.2 Food Insecurity, College Students, and the COVID-19 Pandemic

College students experience food insecurity at higher rates than the general population of Americans, with nearly half of all college students being considered food insecure (Weaver, 2020) compared to only 11.8% of all Americans (USDA, 2022). With the onset of the COVID-19 pandemic, this problem has dramatically worsened, with the rate of food insecurity doubling among college students (Owens, 2020; Mialki 2020; Sidebottom 2021). This is likely due to the initial lack of government relief funds, changes in employment and housing situation, and perceived safety of traveling to purchase food, among other factors (Mialki, 2020).

Due to the COVID-19 pandemic, university campuses were forced to completely shut down from March 2020 – August 2020, causing a major disruption in the lives of college students. Students were no longer able to live in dormitories or utilize campus resources such as, dining halls, on-campus food pantries, and recreational centers. Additionally, many students were unable to keep their employment status at on or off campus jobs due to relocation, further contributing to financial hardships (Owens et al., 2020). The initial financial burden on college students was especially cumbersome, as most did not qualify for the initial government provided relief efforts (Mialki, 2020). Moreover, economic aid during this time was exclusively available for US citizens, putting international students at an increased disadvantage.

After campus shut down, there were increased economic relief efforts for college students aimed to reduce hardships experienced as a direct result of COVID-19. For example, the American Rescue Plan (ARP) provided funds to be distributed to students who were financially impacted by the pandemic (U.S. Department of the Treasury, 2021). The University of Georgia Higher Education Emergency Relief (HEER) Fund distributed these funds to students who were eligible, with the highest amount given to Pell Grant recipients. Pell Grants are awarded to undergraduate students who have household incomes less than $60,000 per year. These federal grants are awarded to students who have exceptional financial needs, and they do not need to be paid back, unlike a loan (US Department of Education, 2022). Eligible students were awarded from $750 to $1250 (University of Georgia, 2022). Due to these increased economic relief efforts, we expect a decrease in the degree of food insecurity among students, post-campus shut down compared to during campus shutdown.

1.3 Innovation

Although insightful, the current research on food insecurity among college students during COVID lacks the differentiation of stages within the pandemic. The literature reflects pre-pandemic times and during pandemic times, however nuances exist within the stages of the pandemic with regards to the accessibility and availability of funds and foods (GAO, 2021). To the best of our knowledge, there are no studies which have examined the impact of campus-wide shut down during the pandemic (March 2020 - July 2020), and the re-opening of college campuses after the height of the COVID-19 pandemic (after August 2020). Therefore, our main objective is to examine the burden and determinants of food insecurity among college students during and after campus shutdown due to the COVID-19 pandemic. The results of this study will

aid institutions and governing bodies in better understanding and preparing for future emergency situations.

1.4 Specific Aims and Hypothesis

Aim 1 compares food insecurity status and dietary diversity during and after campus shut down among college students. It is well documented that food security status is correlated with higher levels of dietary diversity due to increased access and availability of nutritious foods. Validated measures will be used, with questions adapted from the 2005 NHIS Five Factor Screener, to assess dietary diversity during campus shut down and post campus shut down (NHIS, 2019). Food insecurity was measured via questions adapted from the six item USDA FSSM (USDA, 2022).

Aim 2 compares physical activity during and after campus shut down among college students. Questions were derived from surveys that have been used in previous research studies that assessed physical activity before and during the COVID-19 pandemic (Sidebottom, 2021). For this study, during campus shut down and post campus shut down time periods are differentiated with each of the questions to examine possible relationship between physical activity and food security status.

Aim 3 examines if changes in financial factors, such as employment or qualification for emergency funds, impacted the level of food insecurity that college students experienced during and after campus shutdown.

Following campus shutdown, there were increased economic relief efforts for college students, aimed to reduce hardships experienced as a direct result of COVID-19. Thus, we expect there to be a decrease in the degree of food insecurity among students, post- campus shutdown

compared to during campus shutdown due to COVID-19. To test this hypothesis, we developed an online questionnaire to survey students' experiences during these time frames.

This thesis is divided into four chapters: chapter one is an introduction to the work as a whole, chapter two is a review of the current literature, chapter three is a manuscript made up of a brief introduction to this project, the methods, results and discussion, and chapter four includes overall conclusions, recommendations, and implications.

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CHAPTER TWO

LITERATURE REVIEW

Food insecurity is a widespread issue across the United States which negatively affects the health and wellbeing of millions of Americans (Gunderson, 2013). Coupled with the detrimental impacts of the COVID-19 pandemic, negative health consequences among vulnerable populations have been magnified (Kim, 2021). Food insecurity and its associated negative health outcomes, such as poorer physical and mental health, are especially prevalent among college students (Landry & Gunderson, 2022). This literature review outlines the existing research regarding food insecurity in general, food security status among college students, impacts of food insecurity on college students, how COVID impacted college students and their food security status, and financial factors associated with COVID for the college population. A gap in the current literature exists, as there are no studies which examine the impact of the campus-wide shut down during the height pandemic (March 2020 – July 2020), and the re-opening of campus after the height of the pandemic (August 2020 – present) on the food security situation of college students. In other words, no study to date has compared the different stages within the COVID-19 pandemic on food insecurity among college students.

2.1 Food Security

Food insecurity is one of the significant public health and nutrition issues in the United States, affecting upwards of 50 million Americans (Gundersen & Ziliak, 2015). Food insecurity is defined by Gundersen and Ziliak as “a condition in which households lack access to adequate

food because of limited money or other resources." It is well documented throughout the current literature that food insecurity is associated with a multitude of adverse health outcomes, with low socioeconomic populations being disproportionately affected (Gundersen & Ziliak, 2015).

Food insecurity is associated with poorer physical and mental health, as well as increased incidences of chronic disease (Gunderson, 2013). Prevalent health issues include higher rates of anemia and asthma, increased BMI, cognitive issues, and behavioral issues (Gunderson, 2013). Decreased physical activity is seen among food insecure populations, which may further contribute to these health problems (Mialki, 2021). Moreover, many chronic diseases are seen at higher rates in food insecure populations, such as obesity, type II diabetes, cardiovascular disease, and certain cancers (Thomas, 2021). Lower nutrient intakes have also been shown to be associated with food insecurity, as food insecure children had lower dietary diversity, and therefore lower diet quality, than their food secure counterparts (Antwi, 2022). These findings are also consistent among adult populations, as a study done by Leung and colleagues in the United States found that food insecurity was significantly associated with a lower Healthy Eating Index score. This study utilized the USDA FSSM to assess household food security and a single 24-hour recall to obtain dietary information about 8,129 low-income adults. Data was pulled from the 1999-2008 NHANES (Leung, 2014). Those who were food insecure consumed more high fat foods, salty snacks, red/processed meats, and sugar sweetened beverages. These dietary habits are all characteristic of poor diet quality, which has been shown to increase the risk of chronic disease.

Poor mental health outcomes are linked to food insecurity. Increased rate of depression, anxiety, shame, chronic stress, lack of concentration and worry about where their next meal will come from are commonly seen in food insecure households (Hawkins, 2021). A study by Afulani

analyzed data from the nationally representative 2015 NHIS with regards to mental health services and severe mental illness. Severe mental illness was measured with Kessler's K6 nonspecific psychological distress scale (Afulani, 2018). The results of the study show an "incremental relationship" between food insecurity and severe mental illness, with the severity of food insecurity experienced increasing with the incidence of severe mental illness (Afulani, 2018). Furthermore, the results of this study revealed that those with a severe mental illness and low food security were most likely to report an inability to afford mental health services (Afulani, 2018). Food insecurity and mental illness are perpetuated by an accompanying inability to afford and utilize mental health resources. Afulani suggests possible mechanisms by which food insecurity contributes to poor mental health, such as low energy intake and therefore low micronutrient intake, which is associated with diagnoses of anxiety and depression. Additionally, the economic strain experienced by those who are food insecure may put individuals at risk for adopting unhealthy coping mechanisms like smoking, use of illicit drugs, and excessive alcohol consumption, all of which negatively impact mental health and general wellbeing (Afulani, 2018).

Food insecurity is largely influenced by buying decisions, which is often related to low socioeconomic status and geographical locations in food deserts and/or food swamps (Hawkins, 2021). A food desert is an area that has limited access to fresh food and produce relating to the distance between people's homes and the supermarket. Travel to a grocery store becomes burdensome for those living in these environments due to long travel times and a potential lack of adequate transportation. Those residing in these areas often resort to quick marts and convenience stores that carry shelf stable, energy dense foods (Hawkins, 2021). An area that is oversaturated with stores that sell primarily energy dense fast foods is referred to as a food

swamp (Hawkins, 2021). Populations living in these environments often consume foods that are high in calories yet low in nutrients, making them more prone to obesity and associated conditions, like hypertension and type II diabetes (Hawkins, 2021).

Determinants of food insecurity include being Black, Hispanic, single or never married, less educated persons and low-income households, as these groups have a higher probability of being food insecure (Gunderson, 2013). Data was collected in December 2010 as part of a supplemental report for the Current Population Survey (CPS) to measure household food security in the United States (Coleman-Jensen, Nord & Carlson, 2011). The CPS is a nationally representative survey that takes into account 54,000 households in the United States (Coleman-Jensen, Nord & Carlson, 2011). Food security status was measured by a series of ten questions, similar to the US FSSM. An additional eight questions were asked if the household had children ages 0-17. The questionnaire can be found on page three of the CPS report via Economic Resource Service USDA (Coleman-Jensen, Nord & Carlson, 2011). According to the results of the CPS survey, rates of food insecurity were higher than the national average of 14.5% among Black households (25.1%), Hispanic households (26.2%), low income households with incomes below 185% of the poverty line (33.8%), and households with children headed by single women (35.1%) (Coleman-Jensen, Nord & Carlson, 2011). Households with married couples had the lowest rates of food insecurity, with 13.8% being food insecure (Coleman-Jensen, Nord & Carlson, 2011).

Household income is also a major determinant, with food insecurity being inversely correlated with income. However, just because a household's income falls below the poverty line does not automatically indicate it is food insecure. Many households' income lie above the poverty line yet they are still food insecure (Gunderson, 2013). The relationship between food

insecurity and the use of federal nutrition programs, such as Supplemental nutrition Assistance Program (SNAP), can be complicated (Coleman-Jensen, Nord & Carlson, 2011). Programs such as SNAP provide food assistance to eligible low-income households. To be eligible for SNAP benefits, household income must be at or below 130% of the poverty line. Generally, the outcome of the use of these programs is that food insecure households, whether they are acutely or chronically food insecure, will become more food secure after utilizing federal resources (Coleman-Jensen, Nord & Carlson, 2011). On the other hand, if a household is above 130% of the poverty line and therefore not eligible to receive SNAP benefits, the household may remain food insecure due to the lack of federal assistance with food and nutrition (Coleman-Jensen, Nord & Carlson, 2011).

SNAP is an effective program in providing access to nutritious foods for low-income families who receive benefits. The program has been shown to lead to reductions in obesity, particularly among children, as participation in SNAP lead to a reduction in obesity by 5.3% (Gunderson, 2013; Krieder, 2012). The study by Krieder and colleagues utilized MTS-MIV-MTR models and pulled data from the 2001-2006 NHANES study. Their main findings were that SNAP participation is associated with moderate reductions in food insecurity and poor health outcomes, including obesity and anemia, with little evidence of any possible downside (Krieder, 2012). Although SNAP provides affordable and nutritious foods to eligible persons, some may not be aware that they are eligible to receive SNAP benefits, which is especially true among college students. A 2018 report from the US Government Accountability Office revealed that almost 2 million at-risk college students did not receive SNAP benefits, despite being potentially eligible (GAO, 2018). Due to this figure, the GAO pushes for more widely spread information regarding information about eligibility for receiving SNAP benefits.

SNAP-Ed program also provides nutrition education SNAP participants (UDSA, 2022). According to the USDA, SNAP-Ed offers evidence-based programs that empower people to incorporate more nutritious foods and increase physical activity in their lives. SNAP-Ed partners with state and local organizations, such as UGA, to deliver these nutrition education materials (USDA, 2022). For example, UGA offers a six-part class series called "Food Talk" that provides participants with ideas for cooking "healthier" recipes, as well as increasing nutrient dense foods and physical activity on a budget (UGA, 2022). Each class is 60 minutes and includes a cooking demonstration and taste test of the recipes (UGA, 2022). Additionally, UGA SNAP-Ed offers newsletters and online courses to the community (UGA, 2022).

Although nutrition education is an empowering tool for low-income families to expand their knowledge, education alone is not enough to combat food insecurity. A 2022 study done by Antwi et al. in Ghana revealed that the most effective strategy to reduce food insecurity is by increasing the accessibility of nutritious foods and adequate resources, rather than nutrition education alone (Antwi, 2022). This longitudinal study used children ages 6-12 and their caregivers in urban and rural settings in Ghana. A total of 116 caregiver- child dyads were used in this study and the majority of households (62.9%) reported some level of food insecurity (Antwi, 2022). Most caregivers in this study were women (73.3%) and only a third (31.1%) of them had an education of Senior High School or above. Most caregiver's primary occupation was trading (34.5%) (Antwi, 2022). Instruments used were 24-hour recall and the 6 item short form US FSSM to examine the relationship between food security, dietary diversity and primary caregivers' nutrition knowledge. The study found that diet diversity was generally low among the children, with about half (50.9%) consuming a highly diverse diet (Antwi, 2022). The food groups that were consumed by the highest proportion of children were grains (96% per 24-hour

recall) and vegetables other than those rich in vitamin A (85% per 24-hour recall). The food groups that were least consumed by the children were organ meats (0% per 24-hour recall), vitamin A rich fruits (4% per 24-hour recall) and other fruits (15% per 24-hour recall). Children in households classified as food insecure were three times more likely than the children living in food secure households to receive a low score in dietary diversity (Antwi, 2022). Moreover, if the primary caregiver had an education of up to at least Senior High School, their children tended to consume a diet with a higher dietary diversity score (Antwi, 2022). However, the caregiver's nutrition knowledge was not related to the child's dietary diversity. For example, some caregivers were aware of the health benefits of milk products, however their child barely consumed any dairy due to a lack of availability and access to these food groups. Nutrition knowledge did not translate to higher diversity in the diet. Therefore, availability and access to food has a greater impact on diet than nutrition knowledge (Antwi, 2022).

2.2 Food Security Status Among College Students

College students experience food insecurity at higher rates than the general population of Americans, with an average of 42% of all college students being considered food insecure (Bruening, 2017) compared to only 11.8% of all Americans (USDA, 2022). The explanation for this is multifaceted. Firstly, the majority of college students are single and newly financially independent. However, access to their families' resources is somewhat of a gray area for many students and may vary among individuals, depending on their home situation (Landry, 2022). More than half of all college students are financially independent from their parents (Freudenberg, 2019), with Black, Hispanic, Latino and first-generation students being less likely to rely on parental financial support (Landry, 2022). This data was collected from a sample of

557 undergraduate students at a large public University in the southeastern United States (Gaines, 2014). Data was collected via a paper-and-pencil survey delivered to participants by research assistants. Eligible students were returning sophomores, juniors, and seniors ages 19-25 (Gaines, 2014). The study instrument assessed students' food insecurity status, food management skills, demographic information, and financial resources (Gaines, 2014). Students were asked about their financial dependance or independence status, including financial support from family members, student loans and/or financial aid (Gaines, 2014). Those who were financially independent were at a significantly higher risk of being food insecure (P = .001) (Gaines, 2014). On the other hand, financial support from family members (P = 0.01) or credit cards (P = 0.007) were inversely associated with food insecurity (Gaines, 2014). Of the students who reported being financially independent, 37.7% were food insecure, compared to only 10.8% of students who were not financially independent. Furthermore, of the students who were not financially independent, 70% were classified as having high food security. Of the students who received financial support from family members, 87% were highly food secure. Conversely, if students did not receive financial support from family members, 41% of those students were food insecure (Gaines, 2014).

A 2017 systematic review, including 59 papers, assessed the prevalence and factors that contribute to food insecurity among university students in the US and abroad. The average sample of the studies examined was 442 undergraduate and graduate students at post-secondary institutions of higher education (Bruening, 2017). Most of the studies used a convenience sample. Measures included were the prevalence of food insecurity, sociodemographic, health, and academic factors related to food insecurity, as well as potential solutions to address the problem of food insecurity at the University level (Bruening, 2017). With regards to

sociodemographic factors, this review showed that Black, Hispanic, Latino; older students; students who are caregivers; lower income students, financially independent students and first-generation students are more likely to experience food insecurity (Bruening, 2017). Contributions to the association between food insecurity and sociodemographic factors include increased financial burden among at risk populations, as well as inadequate knowledge about nutrition and food assistance resources (Landry, 2022).

Along with the new financial independence that many college students experience, additional financial factors may contribute to college students' higher rates of food insecurity. Students often have full or part time jobs that pay close to minimum wage, which leads to students often working several jobs to pay their way through college (Freudenberg, 2019). This may lead to time conflicts regarding the prioritization of school or work. Their grades may suffer because they must take care of financial obligations rather than spending time studying or completing coursework (Freudenberg, 2019). Moreover, college itself is becoming more expensive, as the cost of a four-year university education has doubled between the years of 1989 and 2016 even after accounting for inflation (Freudenberg, 2019). Living expenses for students, such as rent, textbooks, food, supplies and transportation have also risen, and financial aid is often not enough to cover all expenses (Freudenberg, 2019).

Food insecurity is a prevalent issue among college students; however, many students are not aware of food assistance programs that they may qualify for. A 2019 study from the Government Accountability Office (GAO) reported that only 43% of college students who are eligible for SNAP benefits are enrolled in the program (Dickinson, 2022; GAO, 2019). This is substantially lower than the 84% of U.S. residents that are eligible and enrolled in SNAP benefits (Dickinson, 2022; GAO, 2019). A few different factors are potentially at play, such as students

being unaware of food assistance programs, like SNAP, because they have never had to enroll in them in the past (Landry, 2022). They may lack knowledge on how to locate and navigate these resources (Landry, 2022). Even if they do possess knowledge about these programs, they may avoid them due to social stigma (Landry, 2022). Additional barriers to enrolling in food assistance programs exist, such as the "SNAP college rule," which puts increased restrictions on college students. Students enrolled at post-secondary institutions must meet all the eligibility requirements of SNAP, plus one of multiple additional requirements (USDA, 2021). According to the USDA's website, additional eligibility criteria include working 20 hours or more per week, being under the age of 18 or over the age of 50, and having a physical or mental disability (USDA, 2021). It is clear that these additional requirements exclude a large portion of potentially at risk college students. This rule was put in place based on the premise that all students receive financial support from their parents, enter college directly after finishing high school and have no additional income or dependents. These assumptions are dated, as today's college students often come from a multitude of untraditional backgrounds (Landry, 2022), and as previously mentioned, many college students are newly financially independent. These rules further perpetuate the increased rate of food insecurity among this population.

2.3 Potential Impacts of Food Insecurity on College Students

Food insecurity has unique and detrimental impacts on college students, namely worse mental health outcomes, academic performance, and health habits. Food insecurity is associated with worse mental health including symptoms of anxiety, depression, and stress. A study conducted at the University of California (UC) system in 2015 reported that food insecure students have lower GPAs and higher proportions of poor mental health indicators when

compared to food secure students (Martinez, 2020). This study collected data from 10 of the UC system campuses, where undergraduate and graduate students were randomly selected to participate in an online survey that assessed mental health, GPA, and food insecurity (Martinez, 2020). The study included a total of 8932 students. Mental health was assessed by the nine item National College Health Assessment II survey (Martinez, 2020). Some of the mental health indicators used in this study were hopelessness, sadness, loneliness, overwhelming anxiety, and extreme depression (Martinez, 2020). The results revealed that food insecure students had significantly higher incidences of mental health indicators (22-83%) when compared to food secure students (11-80%) (Martinez, 2020).

Furthermore, Martinez revealed a significantly higher proportion of food secure students reported having a GPA equivalent to an "A" (50%) compared to those who experienced food insecurity (30%). Significantly more food insecure students reported a GPA equivalent to a "C" (19%) compared to those who were food secure (9%) (Martinez, 2020). These findings are consistent with the previously reported 2017 systematic review by Bruening and colleagues, which found that eight studies in the review reported disadvantageous academic consequences, such as difficulty concentrating in class, lower GPA, and even a higher prominence of withdrawing from a class or the institution (Bruening, 2017).

Additionally, food insecure students are more likely to work for pay and have lower GPAs than those who do not work (Van Woerden, 2019). This may be due to more of their time being spent working rather than studying. However, this is necessary for these students as financial priorities often outweigh any academic responsibilities they may have. These added financial responsibilities may add additional stress on low socioeconomic and food insecure populations on college campuses. Lower grades and higher stress are barriers to academic

success (Freudenberg, 2019), which can have lasting impacts students' ability to learn, career outcomes, and their physical and mental wellbeing.

Health behaviors are inversely related to food insecurity. A secondary analysis of a large, NIH funded study by Bruening and colleagues revealed that food insecurity was more prevalent among college students who did not consume breakfast regularly, who had poor eating habits on campus, who did not get adequate sleep, and who reported feelings of anxiety (Bruening, 2018). This study assessed the nutrition, physical activity, and weight outcomes on college freshmen on three campuses living in dormitories at a metropolitan University (Bruening, 2018). Participants were recruited via floor meetings held at residence hall meetings during the 2015-2016 fall and spring semesters (Bruening, 2018). Data from the SPARC (Social impact of Physical Activity and nutRition in College) survey was analyzed, as well as additional anthropometric data collected during August 2015, November 2015, January 2016, and April 2016 (Bruening, 2018). The results of the study found that, of those who were food insecure, 46% consumed breakfast more than 4 days per week, which is significantly less than 63% of those who were food secure (Bruening, 2018). Additionally, a study done by El Zein and colleagues examined the associations of food insecurity with obesity and dietary intake (El Zein, 2020). Participants included 683 second year students at eight universities in the United States (El Zein, 2020). Instruments used were the USDA FSSM and the Dietary Screener Questionnaire (El Zein, 2020). This study found that food insecure college students have significantly higher BMIs than food secure college students. More specifically, those who were food insecure had an average BMI of 26, while those who were food secure had an average BMI of 24.2. Additionally, food insecure students had lower intake of fruits and vegetables (1.6 compared with 2.2) and higher intakes of sugar from sugar sweetened beverages (6.4 compared with 4.5) compared to food secure students

(El Zein, 2020). These findings are echoed by the previously mentioned 2017 systematic review by Bruening and colleagues, which found that food insecurity was correlated with worse eating patterns, as defined by less fruit and vegetable consumption (Bruening, 2017). These findings demonstrate that food security status may influence students' health decisions. It is important to note that there may be other factors at play, such as a lack of adequate nutrition knowledge among students from low socioeconomic communities, as these issues are intertwined.

2.4 Background on the COVID-19 Pandemic

COVID-19 is a novel virus caused by SARS-CoV-2. The virus was first discovered in late 2019 in Wuhan, China (CDC, 2020). The virus quickly spread worldwide, resulting in the COVID-19 pandemic. The virus first reached the United States in late January 2020 (CDC, 2020). On March 13, 2020 a nationwide emergency was declared by the President of the United States (CDC, 2020). Following this state of emergency, the public school system, restaurants and bars, cruise ships, and other businesses were forced to shut down due to public health concerns surrounding the pandemic. A vaccine was not available at this time, so preventative measures of reducing the spread of the virus were enforced, such as social distancing and mask wearing (CDC, 2022).

On March 26, 2020, the U.S. Senate passed the Coronavirus Aid, Relief and Economic Security (CARES) Act, which provided $2 trillion to hospitals, small businesses and state and local governments for economic relief of hardships associated with the pandemic. At the start of April 2020, mask guidelines were updated by the CDC to include recommendations that all people wear a mask when outside of their home. Despite major public health concerns in the U.S., President Trump announced that the United States will discontinue funding the World

Health Organization on April 13, 2020 (CDC, 2020). During this time, the U.S. had the highest death rate due to COVID-19 worldwide, with 23,036 deaths reported as of April 10, 2020, only 4 months after the virus had touched down in the United States (CDC, 2020). Three states, Georgia, Alaska, and Oklahoma began to reopen even though health experts advised against this (CDC, 2022).

By mid 2020, the U.S. unemployment rate reached the highest it has been since the Great Depression (14.7% as of May 9, 2020). 20.5 million people were unemployed, with hospitality, leisure and healthcare being the most affected (CDC, 2020). Low income and minority workers were hit the hardest, as these populations were considered "essential workers" during this time (CDC, 2020). They had the added impact of having to report to work despite health dangers, while earning low wages. Additionally, these people were the most expendable in the workforce so they were often laid off in attempt to keep the business alive during these tough economic times (CDC, 2022). Due to this, racial disparities during the pandemic were prevalent in the workforce and healthcare settings. With this rise in unemployment also came a rise in food insecurity. By October of 2020, food insecurity among Americans reached 52 million people as a result of the pandemic. This is a 17 million increase from pre-pandemic numbers (CDC, 2022).

By August 2020, university campuses re-opened, however classes were offered in a "hybrid" format to reduce in person contact with other people. Masks were enforced on campuses. By spring semester 2021, in person classes became an option for students again, although zoom classes were still offered. Mask wearing continued to be enforced inside university buildings. In February of 2021, the FDA approved the emergency use authorization for vaccines against COVID-19. Moderna, Pfizer and Johnson and Johnson vaccines began to be administered to the public. This allowed vaccinated people to safely travel and gather indoors

without masks (CDC, 2022). The vaccines allowed the American economy to start getting back to normal, although some businesses still required masks and social distancing.

2.5 How the COVID-19 Pandemic Has Impacted College Students' Food Security Status

The COVID-19 pandemic has detrimental impacts on the food security status of college students in the United States. One study done at a large public university in Florida showed that approximately one in five students (22.6%) became less food secure after the onset of COVID-19 (Mialki, 2021). This study utilized an online survey tool, Qualtrics, to gather data from all undergraduate and graduate students at this institution. The survey was open for 3.5 weeks in April 2020 (Mialki, 2021). The six-item US FSSM was used to assess students' food security status before the COVID-19 pandemic and after the onset of COVID-19 (Mialki, 2021). Food security was calculated by assigning a "1" to responses that were affirmative for food insecurity, and a "0" to responses that were negative for food insecurity. Scores were then categorized into groups based on the severity of food insecurity, with "high food security" being raw score of 0 and "very low food security" being a raw score range from 6-10 (Mialki, 2021). Over half (53.4%) of participants had a change in housing due to the pandemic (Mialki, 2021).

Changes in food security were associated with changes in housing and employment as a result of COVID (Mialki, 2021). Many students were unable to work part-time or full-time jobs they previously held due to the economic strain on businesses, as well as public health concerns (Mialki, 2021). The majority of students (88.6%) moved back in with their parents, however this did not guarantee increased access to food, as Mialki et al. showed similar percentages of students becoming more (17.9%) and less (19.9%) food secure after moving home (Mialki, 2021). On the other hand, 3.1% of students remained living on campus during the quarantine

period (Mialki, 2021). Although on campus dining halls and food pantries remained open with appropriate safety measures in place, 29.6% of students who stayed on campus became more food insecure (Mialki, 2021). Of the students who stayed on campus during shut down, the majority (71.4%) experienced no change in employment, indicating that perhaps these students remained because of employment requirements (Mialki, 2021).

In line with Mialki and colleagues' findings, another study showed that the strongest predictors of food insecurity after the onset of COVID were a change in current living arrangement, being furloughed, or being laid off due to the pandemic (Owens, 2020). This study utilized an online survey platform, PsychData, to collect data (Owens, 202). Data was collected on three campus locations at a large Texas university to assess the prevalence of food insecurity during the COVID-19 pandemic (Owens, 2020). Eligible participants were all undergraduate and graduate students at all three University campuses (Owens, 2020). The majority of this study's participants were undergraduate, white females (Owens, 2020). The 6 item USDA food security model (FSSM) was used to assess food security status among college students. A two item Food Sufficiency Screener preceded the 6 item FSSM to screen out those did not classify as food insecure (Owens, 2020). Those who were screened out did not complete the 6 item FSSM (Owens, 2020). Owens and colleagues found that undergraduate students, minority students (including black, Hispanic and Asian/pacific islander), single parents, younger, and overweight or obese students were more likely to be food insecure (Owens, 2020). Over one in three college students experienced food insecurity during the last 30 days of this 2020 study, which is 15% higher than the rate of food insecurity previously reported in 2019 using the same food security assessment (Owens, 2020). These findings illustrate the scope of the food security issue on college campuses, especially following the start of the pandemic.

With changes in food security status during the pandemic also came changes in dietary and physical activity patterns. A 2021 study done by Sidebottom and colleagues aimed to explore the impacts of the COVID-19 quarantine period on physical activity, dietary habits, and food insecurity among college students (Sidebottom, 2021). Eligible participants were undergraduate and graduate students ages 18-24 who perceived a change in their physical activity or dietary patterns during campus wide shut down (Sidebottom, 2021). Data was collected via an online survey tool, Qualtrics, that was open from November 4, 2020, to November 23, 2020 (Sidebottom, 2021). The survey consisted of a sociodemographic block, physical activity/exercise habit changes block, and dietary habit changes block (Sidebottom, 2021). Results revealed that individuals who indicated not being able to afford healthy and balanced meals significantly increased by 54% from pre-pandemic to during the pandemic (Sidebottom, 2021). Those who reported skipping meals or eating less than they felt they should because of lacking money or food increased by 68% (Sidebottom, 2021). Moreover, a significant increase in the frequency of meals eaten at home was observed from pre- to during COVID-19 (Sidebottom, 2021). With regards to physical activity habits, sedentary behavior increased from 4 hours per day to 7 hours per day. Vigorous, moderate, and light physical activity all decreased during the COVID-19 quarantine period (Sidebottom, 2021). Vigorous physical activity decreased from two days per week to one day per week, moderate physical activity decreased from 4 days per week to one day per week, and light physical activity decreased from four days per week to two days per week (Sidebottom, 2021). With university campuses and most businesses shut down during this time period, many people stayed in the comfort of their own homes, naturally decreasing physical activity (Sidebottom, 2021).

2.6 Financial Factors Associated with COVID for the College Population

Due to the COVID-19 pandemic, university campuses were forced to completely shut down from March 2020 – August 2020, causing a major disruption in the lives of college students. Students were no longer able to live in dormitories or utilize campus resources such as, dining halls, on-campus food pantries, and recreational centers. Additionally, many students were unable to keep their employment status at on or off campus jobs due to relocation, further contributing to financial hardships (Owens et al., 2020). The initial financial burden on college students was especially cumbersome, as most did not qualify for the initial government provided relief efforts (Mialki, 2020). Moreover, economic aid during this time was exclusively available for US citizens, putting international students at an increased disadvantage.

Many college students did not qualify for the initial economic relief programs at the start of the shutdown period, contributing to the magnified strain on college students. The Economic Impact Payments (EIPs) provided individuals who met eligibility criteria with an initial $1200, and a subsequent $600. However, if a parent claimed their college student child as a dependent, then the student was not eligible for the payment. Furthermore, parents were not eligible for additional economic help for their college student if they were over 17 years old (Mialki, 2021). The CARES Act and Higher Education Emergency Relief Fund provides funding to institutions for emergency financial aid. The amount of money allocated to each eligible student varies based on their individual financial needs. Online, international and DACA students were not eligible for these relief funds provided by universities, putting these student sub-populations at an increased disadvantage (Mialki, 2021).

The USDA has responded to the food security crisis during COVID by increasing funding for federal nutrition programs, such as WIC and SNAP, but this has not been effective,

as many food banks have reported increased demands of food and supplies (Mialki, 2021). Moreover, SNAP policies exclude a large portion of college students from receiving benefits, and those who do qualify may not be aware of their eligibility status (Mialki, 2021). Almost 2 million SNAP eligible college students reported not receiving benefits (US Government Accountability Office, 2018).

After campus shut down, there were increased economic relief efforts for college students aimed to reduce hardships experienced as a direct result of COVID-19. For example, the American Rescue Plan (ARP) provided funds to be distributed to students who were financially impacted by the pandemic (U.S. Department of the Treasury, 2021). The University of Georgia Higher Education Emergency Relief (HEER) Fund distributed these funds to students who were eligible, with the highest amount given to Pell Grant recipients. Eligible students were awarded from $750 to $1250 (University of Georgia, 2022). The purpose of these funds was to aid students who were most in need of financial assistance due to hardships caused by the pandemic. UGA continues to distribute these funds on a semesterly basis to help reduce to lasting economic impact COVID-19 has caused.

As outlined in this chapter, the majority of research regarding COVID-19's impact on college students' food security status has compared pre-pandemic with pandemic levels. Although insightful, these studies lack the differentiation of stages within the pandemic. This study will explore a gap in the scientific literature on food security status among college students, as it will establish the impact of COVID-19 on food security during and after campus shutdown. Moreover, this study will provide a differentiation of specific stages within the

pandemic and offer unique insight into the burdens and determinants of food insecurity during these unprecedented times.

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CHAPTER THREE

INFLUENCE OF COVID-19 ON FOOD INSECURITY AMONG COLLEGE STUDENTS DURING AND AFTER CAMPUS SHUTDOWN[1]

[1] Leonard, Jacey. To be submitted to *Journal of American College Health.*

Abstract

Background: Food insecurity is one of the United States' largest public health and nutrition issues, affecting upwards of 50 million Americans. It is well documented throughout the current literature that food insecurity is associated with a multitude of adverse health outcomes. College students are disproportionately affected by food insecurity. Paralleled with the onset of the COVID-19 pandemic in March 2020, food insecurity rates doubled among college students.

Objectives: This study examined the burden and determinants of food insecurity among college students during and after campus shutdown due to the COVID-19 pandemic.

Methods: This study was a cross-sectional, self-report, online survey hosted on the "Qualtrics" platform.

Results: Out of the 1980 participants with complete data for the key study variables, majority were primarily white, male, and self-identified their immigration status as domestic (American citizens or permanent residents) students. During campus shut down, three-quarters (75.3%) of participants reported being food secure, while 68.1% reported being food secure after campus shut down. Diversity in participants' diet was higher after campus shut down (61.9% compared to 59.7%), although this was not significantly significant. The frequency of structured workouts and overall physical activity was higher after campus shut down compared to during campus shut down, with 45% reporting an increase in physical activity. The number of participants who received emergency funding, such as the HEER grant, after shut down was higher, with about a fifth receiving funding during shut down and nearly a quarter receiving funding after shut down. Significant independent predictors of food insecurity include impact of COVID-19 on

employment (during p=.002; after p=<.0001), receipt of emergency funding (during and after p= <.0001), and immigration status (during p=.001; after p=.034). Significant independent predictors of dietary diversity include receipt of emergency funding (during p=<.0001; after p=.008) and food security status (p=<.0001).

Conclusions: The results of this study reveal the influence of COVID-19 on food security status during and after campus shut down. The findings show that food insecurity increased, overall dietary diversity improved, physical activity and structured workouts increased, after campus shut down compared to during shut down.

3.1 Introduction

Food insecurity, defined as a state where "the availability of nutritionally adequate and safe foods or the ability to acquire acceptable foods in socially acceptable ways is limited or uncertain" is a widespread issue across the United States that negatively affects the health and wellbeing of millions of Americans (Anderson, 1990; Gunderson, 2013). As of 2022, 11.8% of households are considered food insecure in the United States (USDA, 2022). The experience of food insecurity is often accompanied by a multitude of adverse physical and mental health outcomes, including obesity, type II diabetes, certain cancers, depression, and anxiety (Thomas, 2021; Hawkins, 2021). Low socioeconomic populations are at a higher risk of these negative health outcomes due to the increased prevalence of food insecurity among these populations (Gundersen & Ziliak, 2015; Maia et al., 2019). Coupled with the detrimental impacts of the COVID-19 pandemic, negative health consequences among vulnerable populations have been magnified (Kim, 2021).

College students experience food insecurity at higher rates than the general population of Americans, with nearly half of all college students being considered food insecure (Weaver, 2020). The onset of COVID-19 exacerbated this issue, as the rate of food insecurity among college students doubled during this time (Owens, 2020; Mialki 2020; Sidebottom 2021). This is due in part to the initial lack of government relief funds, changes in employment and housing situation, and perceived safety of traveling to purchase food (Mialki, 2020). Due to the COVID-19 pandemic, university campuses were forced to completely shut down from March 2020 – August 2020, causing a major disruption in the lives of college students. Students were no longer

able to live in dormitories or utilize campus resources such as, dining halls, on-campus food pantries, and recreational centers. Additionally, many students were unable to keep their employment status at on or off campus jobs due to relocation, further contributing to financial hardships (Owens et al., 2020). The initial financial burden on college students was especially cumbersome, as most did not qualify for the initial government provided relief efforts (Mialki, 2020). Moreover, economic aid during this time was exclusively available for US citizens, putting international students at an increased disadvantage.

After campus shut down, there were increased economic relief efforts for college students aimed to reduce hardships experienced as a direct result of COVID-19. Federal grants, such as the Higher Education Emergency Relief (HEER) Fund, were awarded to those who are in exceptional financial need, with Pell Grant recipients being awarded the highest amounts. Pell Grants are awarded to undergraduate students who have household incomes less than $60,000 per year (US Department of Education, 2022). These emergency relief funds were directly deposited into recipients' bank account, allowing them to spend the funds at their discretion.

Although insightful, the current research on food insecurity among college students during COVID lacks the differentiation of stages within the pandemic. The literature reflects pre-pandemic times and during pandemic times, however nuances exist within the stages of the pandemic with regards to the accessibility and availability of funds and foods (GAO, 2021). To the best of our knowledge, there are no studies which have examined the impact of campus-wide shut down during the pandemic (March 2020 - July 2020), and the re-opening of college campuses after the height of the COVID-19 pandemic (after August 2020). Therefore, our main objective was to examine the burden and determinants of food insecurity among college students during and after campus shutdown due to the COVID-19 pandemic. The specific aims of this

study are (i) to compare food insecurity status and dietary diversity during and after campus shut down among college students, (ii) to compare physical activity during and after campus shut down among college students, and (iii) to examine if changes in financial factors, such as employment or qualification for emergency funds, impacted the level of food insecurity that college students experienced during and after campus shutdown. The findings of this study provide useful insights for universities and other agencies on ways to combat food insecurity on college campuses during emergency situations.

3.2 Materials and Methods

3.2.1 Study Design

This study was a cross-sectional, self-report, online survey hosted on the "Qualtrics" platform. The link to the survey was sent via email to all Spring 2022 enrolled undergraduate and graduate students at the University of Georgia (UGA). The study was reviewed and approved by the Human Subject Institutional Review Board (PROJECT00004966) of the University of Georgia.

3.2.2 Study Site and Participant Recruitment

The study was conducted at The University of Georgia, a large public land grant university located in Athens, Georgia. Overall enrollment at UGA in 2022 was 40,118. The total number of undergraduate students was 30,166 and the total number of graduate students was 9,952 (University of Georgia, 2022). To be eligible, participants must have been enrolled as a student during Spring 2020, 18 years or older and either a sophomore, junior, senior, or graduate student at UGA at the time of the survey. Freshmen and first year graduate students were excluded because they did not attend UGA during Spring 2020, the height of the COVID19 pandemic. Screener questions at the beginning of the survey filtered out those who were ineligible from participating. The first screener question was "Are you 18 years or older?" and the second was "What is your UGA classification by year, not by credits?"

3.2.3 Survey Instrument

Questions for the survey instrument were collated from questions that have been validated and used in previous research studies that assessed food insecurity before and during

the COVID-19 pandemic (Owens, 2021; Mialki, 2020). Relevant questions were adapted from those surveys to serve as the backbone, and additional questions were included to address the specific objectives of this study. The survey consisted of 5 main sections preceded by a food sufficiency screener. Seven questions regarding sociodemographic information were asked in the beginning of the survey to determine the participants' age, gender, ethnicity/race, citizenship, pre-existing health conditions and health insurance status, and immigration status (e.g., Are you an international student, defined as a "non-immigrant" visitor who is in the United States temporarily for school). The sections following the screener were food security questions adapted from the six item USDA FSSM (USDA, 2022), dietary diversity (e.g., From August 2020-present (after campus shut down), how often did you eat FRUIT? Count fresh, frozen, or canned fruit. Do NOT count juices.), physical activity (e.g., Has your physical activity increased, decreased or stayed the same from campus shut down (March-July 2020) to after campus shutdown (August 2020-present)?), financial (e.g., Are you currently receiving either Supplemental Nutrition Assistance Program (SNAP), Special Supplemental Nutrition Program for Women, Infant, and Children (WIC), or another type of food assistance?). The survey consisted of 35 questions, including multiple choice, matrix table and text entry prompts that was designed to take an average of 15-20 minutes to complete.

The survey launched on February 7, 2022 and remained open until April 29, 2022. Participants were initially contacted via email. An initial follow up reminder email was sent out after one week and subsequent reminder emails were sent out every other week. Additionally, professors made announcements before class periods to remind students about and to complete

the survey. Participants consented to the study after reading the consent script prior to answering the survey questions.

3.2.4 Measures

Food Insecurity

The food insecurity question block was adapted from the six item USDA FSSM (USDA, 2022). These questions were asked to assess food security status. Answers were either affirmative or negative for food insecurity (1= affirmative, 0= negative) following the USDA Guide to Measuring Household Food Security. For five questions, responses that were affirmative for food insecurity also included higher and lower severity food insecurity (1= affirmative, lower severity, 2= affirmative, higher severity, 0= negative). The remainder did not specify between lower and higher food insecurity. Preceding this section was the two-item food sufficiency screener. The screener was adapted from Owens et al (2020) and would have served to screen out those who experienced low levels of food insecurity.

Dietary Diversity

The dietary diversity block contained six questions targeting students' intake of pre-packaged foods, fast food, and fruits/vegetables to assess whether there was a change in dietary diversity from during to post campus shutdown. During campus shut down (March - July 2020) and post campus shut down (August 2020 – present) time periods were differentiated within each of the questions. The first two questions used a Likert scale to determine if participants often chose pre-packaged foods and fast food, and if these types of foods are preferred due to their convenience or cost. Four questions were asked to assess the number of fruits and vegetables

participants usually consumed during the week. Participants were instructed to include fresh, frozen, and canned fruit in their count and to exclude fruit juices. For vegetables, green leafy salads and other starchy and non-starchy vegetables were included in participants' count. These were validated measures adapted from the 2005 NHIS Five Factor Screener (NHIS, 2019). It should be noted that this measure of dietary assessment takes in to account the frequency of food groups consumed over a period, rather than the precise number of cups or ounces of food groups. Therefore, a limitation of the chosen measure is that it does not provide information about if participants are consuming the recommended amounts per the Dietary Guidelines for Americans. However, this measure was chosen over other measure of dietary assessment, such as a 24-hour recall or food frequency questionnaire (FFQ), due to participant burden. A 24-hour recall or FFQ would have been too lengthy to include in our survey and would likely have contributed to survey fatigue.

Physical Activity

The physical activity block contained 4 items to assess change in physical activity over the two time periods. Questions were adapted from surveys that have been used in previous research studies that assessed physical activity before and during the COVID-19 pandemic. Questions were primarily adapted from Sidebottom et al (2021). The first two questions simply ask if participants feel their physical activity and day to day activity has increased, decreased, or stayed the same. The last two questions ask about the frequency of a structured workout, defined as activities like running or resistance training. Indirect measures of physical activity were chosen over direct measures, such as instructing participants to wear apple watches to determine precise amount of physical activity during the two time periods, due to the nature of our research.

Our study was retrospective, as participants had to recall past levels of physical activity. It would be impossible to go back in time and record activity levels. In addition to this, we did not have the funding to provide apple watches to all participants. Therefore, indirect measures were the most appropriate for the current study.

Finances

The financial block contained six questions targeting any financial assistance that students may have access to and how the pandemic has potentially impacted their household income. Participants were asked if they were recipients of any public food assistance program, such as WIC or SNAP benefits, whether their employment was directly affected by the pandemic and if they received emergency funding through UGA, such as the HEER grant or CARES Act.

3.2.5 Statistical analysis

All analyses were conducted using SPSS software for Windows (version 27). For analysis, a p-value of <0.05 was considered as a criterion for statistical significant. The dataset was downloaded from Qualtrics and imported into SPSS, coded, cleaned, and checked for missing responses. Participants with missing responses were excluded from the dataset and only participants with complete responses were included in the final analysis. Several variables were recoded based on participant responses and sample size. The race/ethnicity variable was originally coded as 1= White, 2= Black/African American, 3= Hispanic/Latino, 4= Asian/Pacific Islander and 5= Other (please specify). Due to participant responses and small sample size in some cases, the race/ethnicity variable was recoded as follows: 1=White, 2=Black/African American, and 3= American Indian, Native Alaskan, Asian, Hispanic and Latino, Native

Hawaiian, and Pacific Islander. The gender variable was originally coded as 1= female, 2= male, 3= non-binary/third gender 4= prefer not to say, and 5= other. This variable was recoded for simplicity based on participants responses so that 1= female, 2= male and 3= gender nonspecific/ other. Additionally, some questions differentiated between lower and higher severity food insecurity. For simplicity and consistency, lower severity and higher severity food insecurity was combined into food insecure group. For the final recoding of the food security status variable, 1= food secure and 2= food insecure. Lastly, COVID's impact on the participant's employment status was coded as "YES" and "NO". Although we collected data on both immigration status and US citizenship, we decided to use immigration status for our analysis. The immigration status question captured whether participants self-identified as international or domestic students. We decided against the use of US citizenship because there may be some participants who are not US citizens but hold green cards and have resided in the US for most of their lives with their families and may have similar benefits as US citizens. Immigration status was chosen over citizenship status because international students without US citizenship status better captures the context of social capital, as these participants will most likely have less social support in the US because their families live abroad.

Dietary diversity scores were calculated by converting weekly frequencies to daily frequencies, per the 2005 NHIS Dietary Screener. Fruit and vegetable consumption during campus shut down were combined, as well as fruit and vegetable consumption after campus shut down and scored. The scores were computed and ranged from 0.43 – 2.00 for both during and after shut down. Measures of central tendency, specifically the median (0.99), were used to determine the cut off point for low and high dietary diversity. This approach was previously used in research on dietary diversity (Antwi, 2022). A classification of low dietary diversity included

scores from 0.43 to 0.99, while a classification of high dietary diversity included scores from 1.00 to 2.00.

Descriptive statistics using Chi-square/Fisher's exact tests were conducted to examine categorical associations between sociodemographic characteristics and food security and dietary diversity status during and after campus shut down. Nonparametric measures, specifically the McNemar test and Wilcoxon signed rank test, were used to assess differences during and after campus shut down in food security status, dietary diversity, and structured workouts. Univariate and multivariate logistic regression were conducted to predict relationships between outcome and exposure variables. Variables from the univariate analyses with significance level of .1 or lower were entered in the multivariate logistic regression analyses to determine independent predictors. Hosmer-Lemeshow Test was used to assess the stability of the multivariate logistic regression models.

3.3 Results

This study examined the burden and determinants of food insecurity and physical activity among college students during and after campus shutdown due to the COVID-19 pandemic. The specific aims of the study were to compare food insecurity and dietary diversity during and after campus shut down, to compare physical activity during and after campus shut down and to examine if changes in financial factors impacted the levels of food insecurity and diet quality that college students experienced during and after campus shut down.

3.3.1 Characteristics of Study Participants

A total of 2440 college students attempted the Qualtrics survey. Four hundred and sixty (460) had incomplete responses and were excluded from the final participant count and analysis. Out of the 1980 participants with complete data for the key study variables, majority (73.7%) were primarily white, male (69.5%), and self-identified their immigration status as domestic (American citizens or permanent residents) students (94.6%). Most (83.4%) did not have any pre-existing health condition. Of those who did have a pre-existing health condition, the common condition was asthma (26.9%). Majority (95.1%) of the participants had health insurance whether it was their own or through a parent or guardian (Table 1).

Table 1. Sociodemographic Characteristics of Participants (N= 1980).

	n (%)
Academic Standing	
Sophomore	608 (30.7)
Junior	401 (20.3)
Senior	376 (19.0)
Graduate student	594 (30.0)
Gender	
Female	548 (27.7)
Male	1376 (69.5)
Non-binary/third gender	56 (2.8)
Ethnicity/Race	
White	1459 (73.7)
Black or African American	155 (7.8)
American Indian or Alaskan Native	11 (0.6)
Asian	256 (12.9)
Native Hawaiian or Pacific Islander	2 (0.1)
Other[2]	95 (4.8)
Immigration Status	
International Student	107 (5.4)
Domestic Student	1872 (94.6)
US Citizenship Status	
US Citizen	1848 (93.3)
Not US Citizen	132 (6.7)
Presence of Pre-Existing Health Condition	
Yes	329 (16.6)
No	1651 (83.4)
Types of Pre-Existing Health Condition	
Diabetes	6 (1.9)
Asthma	87 (26.9)
Cancer	4 (1.2)
Heart Disease	7 (2.2)
Depression	42 (13.0)
Anxiety	25 (7.7)
Other[3]	153 (47.2)
Health Insurance Status	
Yes	1883 (95.1)
No	75 (3.8)

[2] Includes biracial, multiracial, Hispanic, and Latino

[3] There were a variety of "other" health conditions that participants reported, including scoliosis, seasonal allergies, Chron's, Ulcerative Colitis, IBD, GERD, gastroparesis, Celiac's Disease, epilepsy, anemia, hypothyroidism, brain injury, endometriosis, PCOS, POTS, ADHD, Bipolar, Narcolepsy, Hashimoto's, hypertension, anorexia, etc…

3.3.2 Food Security Status During and After Campus Shut Down

Participants reported increased food insecurity after campus shut down (Table 2) which was statistically significant ($p < .0001$). During campus shut down, three-quarters (75.3%) of participants reported being food secure, while after campus shut down only 68.1% reported being food secure. Both lower severity food insecurity and higher severity food insecurity levels was higher after campus shut down compared to during campus shut down. Nearly a fifth (18.9%) of participants reported lower severity food insecurity and a small percentage (5.8%) reported higher severity during campus shut down. After campus shut down, nearly a quarter (24.6%) of participants reported lower severity food insecurity and a small percentage (7.3%) reported higher severity. Despite more participants becoming food insecure after shut down, the majority of participants (69.4%) reported no perceived change in food security status from during shut down to after shut down. About a fifth of participants reported reducing the size of their meals due to not having enough money for food (Figure 1). The frequency that participants reduced their meal size during and after shut down can be found in Figure 1.

Table 2. Food Security During and After Campus Shut Down by Participant Characteristics.

	During Campus Shut Down			After Campus Shut Down		
	Food Secure n (%)	Food Insecure n (%)	p-value	Food Secure n (%)	Food Insecure n (%)	p-value
Academic Standing						
Sophomore	357 (29.5)	89 (22.4)	.010	315 (28.8)	131 (25.5)	.094
Junior	256 (21.1)	78 (19.6)		221 (20.2)	112 (21.8)	
Senior	222 (18.3)	95 (23.9)		200 (18.3)	117 (22.8)	
Graduate student	376 (31.0)	136 (34.2)		359 (32.8)	153 (29.8)	
Gender						
Female	349 (28.8)	109 (27.4)	.218	315 (28.8)	144 (28.1)	.319
Male	833 (68.8)	273 (68.6)		754 (68.9)	350 (68.2)	
Gender non-specific and other	29 (2.4)	16 (4.0)		26 (2.4)	19 (3.7)	
Ethnicity						
White	935 (77.2)	269 (67.6)	<.0001	845 (77.2)	358 (69.8)	.002
Black/African American	78 (6.4)	42 (10.6)		67 (6.1)	53 (10.3)	
Other[1]	198 (16.4)	87 (21.9)		183 (16.7)	102 (19.9)	
Immigration Status						
International Student	49 (4.0)	33 (8.3)	.001	48 (4.4)	34 (6.6)	.057
Domestic Student	1162 (96.0)	365 (91.7)		1047 (95.6)	479 (93.4)	

[1] Includes American Indian, Native Alaskan, Asian, Hispanic and Latino, Native Hawaiian, and Pacific Islander.

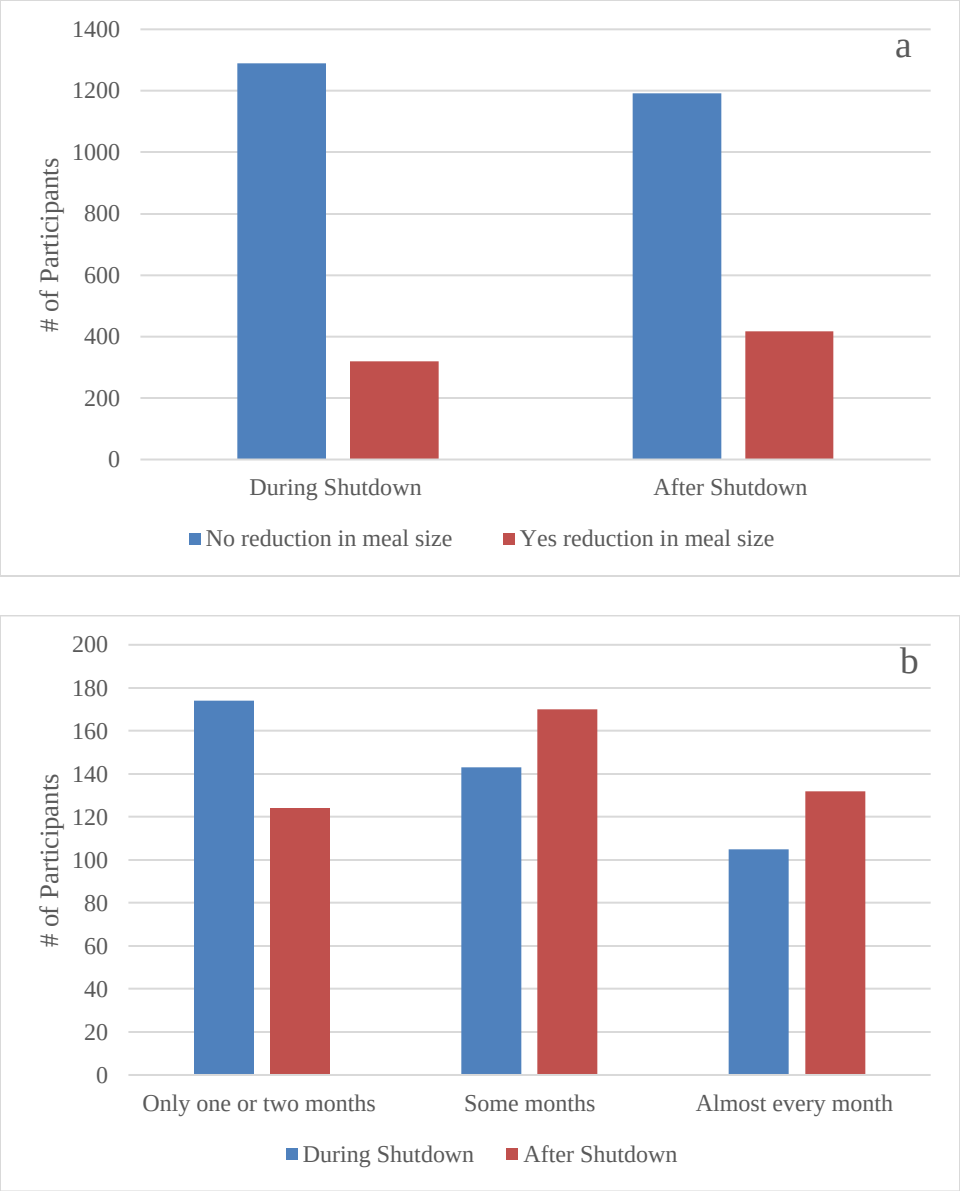


Figure 1. Reduction in meal size (a) Reduction in meal size during and after campus shut down.

(b) Frequency of reduced meal size during and after campus shut down.

3.3.3 Dietary Diversity During and After Campus Shut Down

The reported diversity in participants' diet was higher after campus shut down (Table 3), however, the difference was not statistically significant ($p = .071$). The majority of participants reporting consumption of balanced meals self-identified as being food secure (Table 4). Participants reported slightly lower fruit consumption 1-2 days per week after campus shut down compared to during shut down. Conversely, participants reported consuming fruit 3-4 days per week slightly more after campus shut down. Additionally, salad and vegetable consumption 1-2 days per week was lower after campus shut down compared to during campus shut down. However, less participants reported consuming salad and vegetables 3-4 days per week during campus shut down compared to after campus shut down. Overall, data collected revealed dietary diversity was better after campus shut down compared to during campus shut down, although these results are not statistically significant. Figure 2 shows the frequency that participants bought pre-packaged food or fast food due to lower cost or convenience.

Table 3. Dietary Diversity During and After Campus Shut Down by Participant Characteristics.

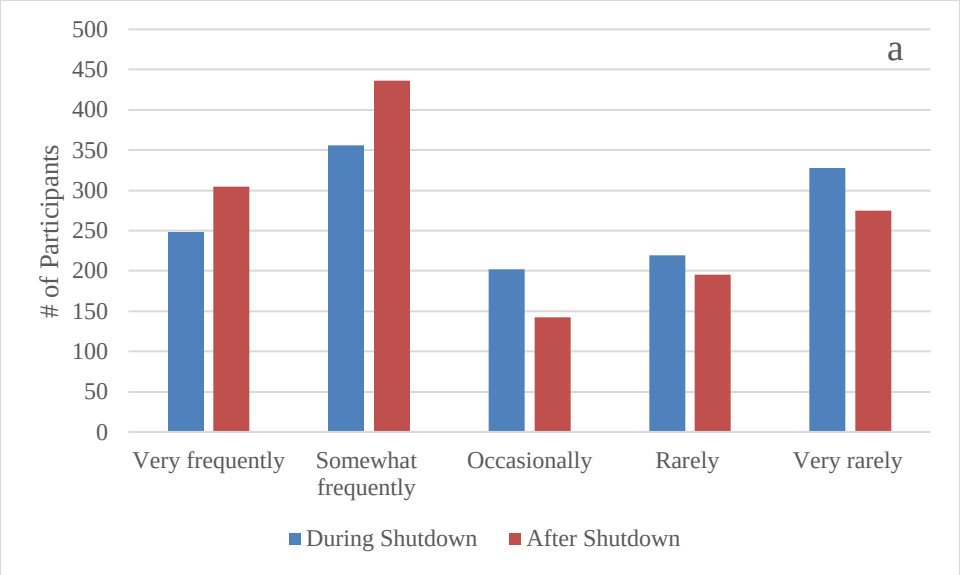
	During Campus Shut Down			After Campus Shut Down		
	Lower Dietary Diversity n (%)	Higher Dietary Diversity n (%)	p-value	Lower Dietary Diversity n (%)	Higher Dietary Diversity n (%)	p-value
Academic Standing						
Sophomore	146 (26.7)	206 (25.5)	.754	139 (26.9)	213 (25.4)	.570
Junior	123 (22.5)	170 (21.0)		118 (22.9)	174 (20.8)	
Senior	106 (19.4)	158 (19.6)		100 (19.4)	164 (19.6)	
Graduate student	171 (31.3)	274 (33.9)		159 (30.8)	286 (34.2)	
Gender						
Female	167 (30.6)	221 (27.4)	.229	169 (32.8)	219 (26.2)	.003
Male	359 (65.8)	565 (69.9)		325 (63.0)	598 (71.4)	
Gender non-specific and other	20 (3.7)	22 (2.7)		22 (4.3)	20 (2.4)	
Ethnicity						
White	405 (74.2)	620 (76.7)	.068	376 (72.9)	647 (77.3)	.066
Black/African American	49 (9.0)	46 (5.7)		46 (8.9)	49 (5.9)	
Other[1]	92 (16.8)	142 (17.6)		94 (18.2)	141 (16.8)	
Immigration Status						
International Student	29 (5.3)	40 (5.0)	.767	25 (4.8)	45 (5.4)	.668
Domestic Student	517 (94.7)	768 (95.0)		491 (95.2)	792 (94.6)	

[1] Includes American Indian, Native Alaskan, Asian, Hispanic and Latino, Native Hawaiian, and Pacific Islander.

Table 4. Consumption of Balanced Meals During and After Shut Down by Participant Characteristics.

	During Campus Shut Down				After Campus Shut Down			
	Food Secure n (%)	Food Insecure, lower severity n (%)	Food Insecure, higher severity n (%)	p-value	Food Secure n (%)	Food Insecure, lower severity n (%)	Food Insecure, higher severity n (%)	p-value
Academic Standing								
Sophomore	300 (27.8)	102 (29.7)	44 (23.9)	.366	264 (27.3)	120 (28.2)	62 (28.4)	.232
Junior	224 (20.7)	71 (20.6)	39 (21.2)		200 (20.7)	85 (20.0)	49 (22.5)	
Senior	205 (19.0)	64 (18.6)	48 (26.1)		178 (18.4)	86 (20.2)	53 (24.3)	
Graduate student	352 (32.6)	107 (31.1)	53 (28.8)		324 (33.5)	134 (31.5)	54 (24.8)	
Gender								
Female	313 (29.0)	97 (28.2)	49 (26.6)	.026	291 (30.1)	101 (23.8)	68 (31.2)	.001
Male	748 (69.2)	231 (67.2)	126 (68.5)		661 (68.4)	303 (71.3)	141 (64.7)	
Gender non-specific and other	20 (1.8)	16 (4.7)	9 (4.8)		14 (1.4)	21 (4.9)	9 (4.1)	
Ethnicity								
White	826 (76.4)	245 (71.2)	133 (72.3)	.326	738 (76.4)	299 (70.4)	167 (76.6)	.042
Black/African American	74 (6.8)	31 (9.0)	15 (8.2)		59 (6.1)	44 (10.4)	17 (7.8)	
Other[1]	181 (16.7)	68 (19.8)	36 (19.6)		169 (17.5)	82 (19.4)	34 (15.6)	
Immigration Status								
International Student	52 (4.8)	19 (5.5)	11 (6.0)	.738	51 (5.3)	24 (5.6)	7 (3.2)	.380
Domestic student	1029 (95.2)	325 (94.5)	173 (94)		915 (94.7)	401 (94.4)	211 (96.8)	

[1] Includes American Indian, Native Alaskan, Asian, Hispanic and Latino, Native Hawaiian, and Pacific Islander.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During Shutdown
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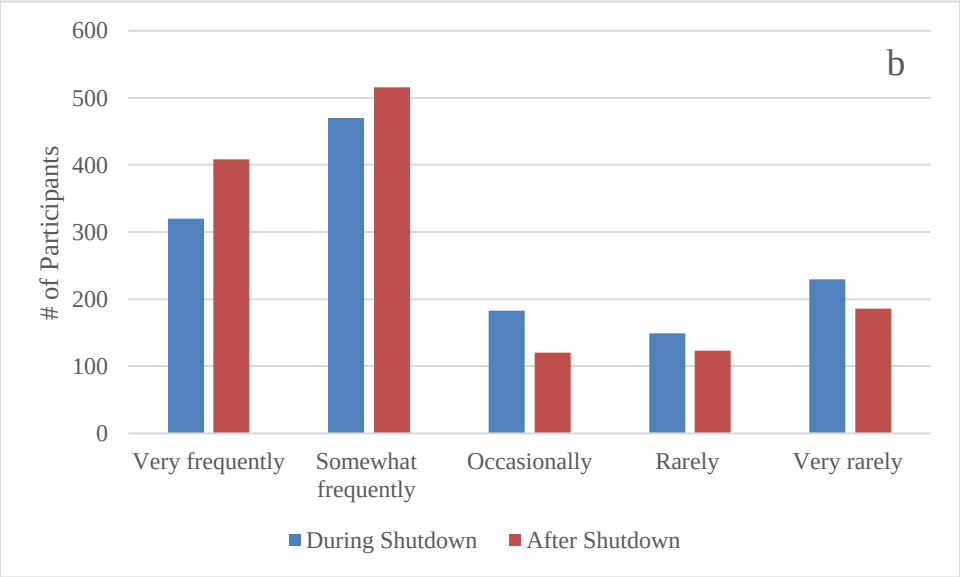
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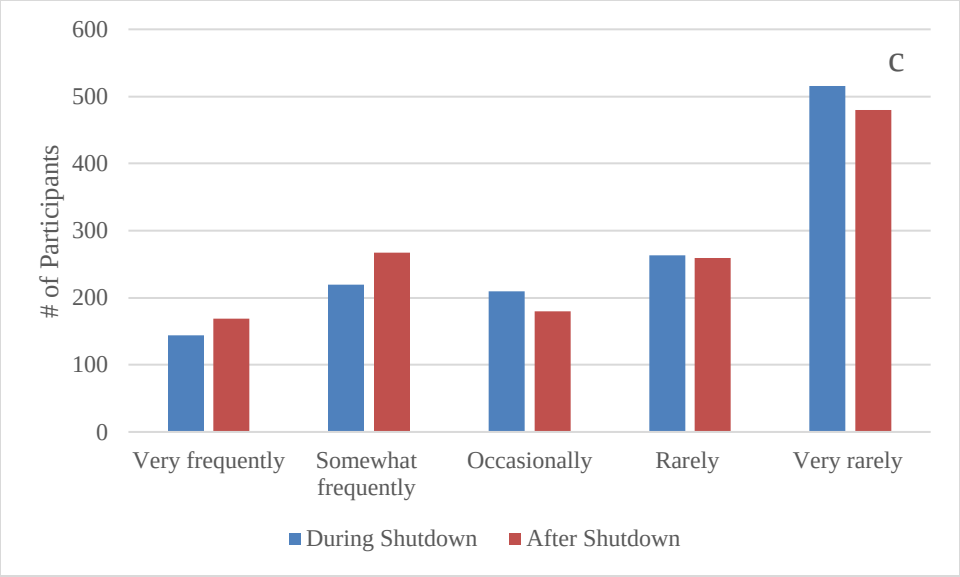

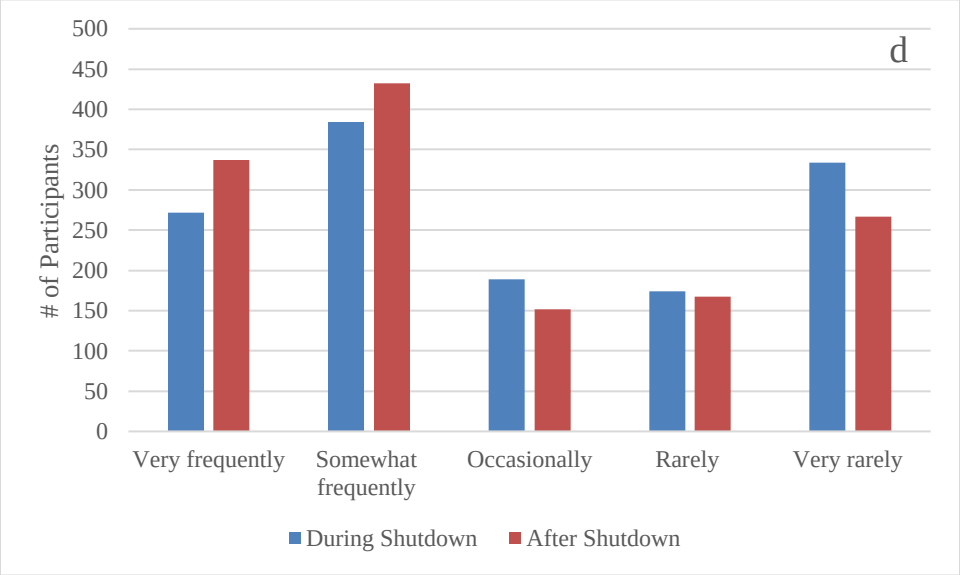

Figure 2. Frequency of pre-packaged food or fast-food purchase during and after campus shut down. (a) Frequency of pre-packaged food purchase due to lower cost. (b) Frequency of pre-packaged food purchase due to convenience. (c) Frequency of fast-food purchase due to lower cost. (d) Frequency of fast-food purchase due to convenience.

3.3.4 Physical Activity Levels During and After Campus Shut Down

The frequency of structured workouts was higher after campus shut down compared to during campus shut down ($p<.001$). During campus shut down, almost half (45.9%) of participants reported engaging in a structured workout, such as running or resistance training, 0-1 days per week. A third (33.5%) reported engaging in a structured workout 2-4 days per week, and a fifth (20.6%) reported 5-7 days per week during campus shut down. After campus shut down, more than a third (38.9%) of participants reported engaging in a structured workout 0-1 days per week, 39.8% 2-4 days per week, and about a fifth (21.3%) 5-7 days per week (Table 5). Furthermore, nearly half of participants reported an increase in physical activity from during campus shut down to after shut down, while about a third reported a decrease in their physical activity from during shut down to after shut down (Table 6).

Table 5. Frequency of Structured Workout During and After Campus Shut Down by Participant Characteristics.

	During Campus Shut Down				After Campus Shut Down			
	0-1 Days Per Week n (%)	2-4 Days Per Week n (%)	5-7 Days Per Week n (%)	p-value	0-1 Days Per Week n (%)	2-4 Days Per Week n (%)	5-7 Days Per Week n (%)	p-value
Academic Standing								
Sophomore	155 (25.2)	116 (25.8)	72 (26.0)	.781	120 (23.0)	145 (27.2)	78 (27.3)	.002
Junior	135 (21.9)	90 (20.0)	68 (23.2)		108 (20.7)	120 (22.5)	65 (22.7)	
Senior	121 (19.6)	86 (19.2)	55 (19.9)		86 (16.5)	107 (20.0)	69 (24.1)	
Graduate student	205 (33.3)	157 (35.0)	82 (29.6)		208 (39.8)	162 (30.3)	74 (25.9)	
Gender								
Female	163 (26.5)	130 (29.0)	89 (32.1)	.031	116 (22.2)	157 (29.4)	109 (38.1)	<.0001
Male	425 (69.0)	308 (68.6)	185 (66.8)		377 (72.2)	367 (68.7)	174 (60.8)	
Gender non-specific and other	28 (4.5)	11 (2.4)	3 (1.1)		29 (5.6)	10 (1.9)	3 (1.1)	
Ethnicity								
White	437 (70.9)	346 (77.1)	234 (84.5)	<.0001	372 (71.3)	407 (76.2)	238 (83.2)	.004
Black/African American	48 (7.8)	31 (6.9)	14 (5.1)		43 (8.2)	39 (7.3)	11 (3.8)	
Other[1]	131 (21.3)	72 (16.0)	29 (10.5)		107 (20.5)	88 (16.5)	37 (12.9)	
Immigration Status								
International Student	35 (5.7)	26 (5.8)	9 (3.2)	.254	32 (6.1)	26 (4.9)	12 (4.2)	.446
Domestic Student	581 (94.3)	423 (94.2)	268 (96.8)		490 (93.9)	508 (95.1)	274 (95.8)	

[1] Includes American Indian, Native Alaskan, Asian, Hispanic and Latino, Native Hawaiian, and Pacific Islander.

Table 6. Changes in Physical Activity from During Shut Down to After Shut Down by Participant Characteristics.

	Increased n (%)	Decreased n (%)	Stayed the Same n (%)	p-value
Academic Standing				
Sophomore	169 (28.0)	90 (22.2)	83 (25.2)	<.0001
Junior	142 (23.5)	83 (20.4)	68 (20.6)	
Senior	138 (22.8)	63 (15.5)	61 (18.5)	
Graduate student	155 (25.7)	170 (41.9)	118 (35.8)	
Gender				
Female	193 (32.0)	95 (23.4)	94 (28.5)	.007
Male	388 (64.2)	304 (74.9)	225 (67.9)	
Gender non-specific and other	23 (3.8)	7 (1.7)	12 (3.6)	
Ethnicity				
White	466 (77.2)	290 (71.4)	259 (78.5)	.033
Black/African American	47 (7.8)	32 (7.9)	14 (4.2)	
Other[1]	91 (15.1)	84 (20.7)	57 (17.3)	
Immigration Status				
International Student	21 (3.5)	33 (8.1)	16 (4.8)	.005
Domestic Student	583 (96.5)	373 (91.9)	314 (95.2)	

[1] Includes American Indian, Native Alaskan, Asian, Hispanic and Latino, Native Hawaiian, and Pacific Islander.

3.3.5 Economic Factors During and After Campus Shut Down

Most (71.9%) of the participants reported that COVID did not affect their employment status either during or after campus shut down. Of the of students who reported a change in employment due to COVID, a small percentage said their employment status was impacted by COVID during shut down (Table 7). Less participants reported an impact after shut down compared to during shut down, and a small proportion reported an impact both during and after shut down (Table 7). The vast majority (95.1%) of participants reported not being recipients of any food assistance program. Of the participants who reported receiving food assistance, most (1.2%) receive SNAP benefits and a few (0.5%) receive WIC benefits. Furthermore, the number of participants who received emergency funding, such as the HEER grant, after shut down was higher compared to during shut down, with about a fifth receiving funding during shut down and nearly a quarter receiving funding after shut down (Table 8 and Figure 3).

Table 7. COVID Impact on Employment During or After Shut Down by Participant Characteristics.

	Impacted During Campus Shut Down n (%)	Impacted After Campus Shut Down n (%)	Impacted Both During and After Campus Shut Down n (%)	No Impact n (%)	p-value
Academic Standing					<.0001
Sophomore	37 (21.9)	8 (21.6)	25 (17.1)	259 (27.0)	
Junior	42 (24.9)	12 (32.4)	28 (19.2)	205 (21.4)	
Senior	50 (29.6)	9 (24.3)	43 (29.5)	156 (16.3)	
Graduate student	40 (23.7)	8 (21.6)	50 (34.2)	338 (35.3)	
Gender					.039
Female	31 (18.3)	15 (40.5)	42 (28.8)	280 (29.2)	
Male	131 (77.5)	21 (56.8)	97 (66.4)	651 (68.0)	
Gender non-specific and other	7 (4.1)	1 (2.7)	7 (4.8)	27 (2.8)	
Ethnicity					.106
White	126 (74.6)	22 (59.5)	102 (69.9)	744 (77.7)	
Black/African American	15 (8.9)	6 (16.2)	12 (8.2)	57 (5.9)	
Other[1]	28 (16.6)	9 (24.3)	32 (21.9)	157 (16.4)	
Immigration Status					.065
International Student	2 (1.2)	4 (10.8)	9 (6.2)	53 (5.5)	
Domestic Student	167 (98.8)	33 (89.2)	137 (93.8)	905 (94.5)	

[1] Includes American Indian, Native Alaskan, Asian, Hispanic and Latino, Native Hawaiian, and Pacific Islander.

Table 8. Receipt of Emergency Funding During and After Campus Shut Down by Participant Characteristics.

	During Campus Shut Down			After Campus Shut Down		
	Received Emergency Funding n (%)	Did Not Receive Emergency Funding n (%)	p-value	Received Emergency Funding n (%)	Did Not Receive Emergency Funding n (%)	p-value
Academic Standing						
Sophomore	41 (15.8)	297 (27.7)	<.0001	63 (20.5)	275 (26.8)	.004
Junior	54 (20.8)	238 (22.2)		58 (18.9)	234 (22.8)	
Senior	64 (24.7)	197 (18.3)		59 (19.2)	202 (19.7)	
Graduate student	100 (38.6)	342 (31.8)		127 (41.4)	315 (30.7)	
Gender						
Female	61 (23.6)	317 (29.5)	.001	71 (23.1)	307 (29.9)	.007
Male	181 (69.9)	732 (68.2)		220 (71.7)	693 (67.5)	
Gender non-specific and other	17 (6.5)	25 (2.3)		16 (5.2)	26 (2.6)	
Ethnicity						
White	175 (67.6)	836 (77.8)	<.0001	207 (67.4)	804 (78.4)	<.0001
Black/African American	38 (14.7)	54 (5.0)		46 (15.0)	46 (4.5)	
Other[1]	46 (17.8)	184 (17.1)		54 (17.6)	176 (17.1)	
Immigration Status						
International Student	3 (1.2)	67 (6.2)	.001	4 (1.3)	66 (6.4)	<.0001
Domestic Student	256 (98.8)	1007 (93.8)		303 (98.7)	960 (93.6)	

[1] Includes American Indian, Native Alaskan, Asian, Hispanic and Latino, Native Hawaiian, and Pacific Islander.

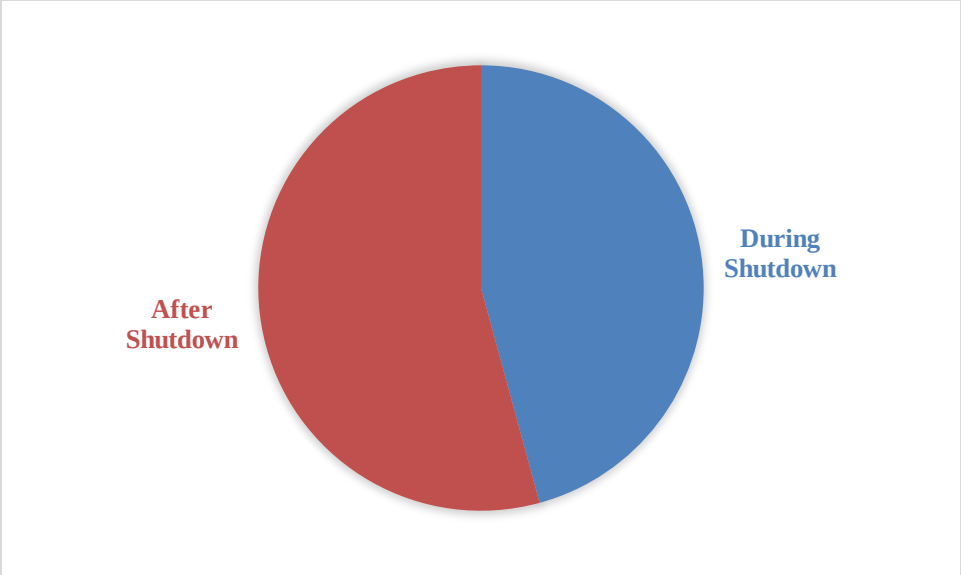

Figure 3. Receipt of emergency funding during and after campus shut down.

3.3.6 Predictors of Food Insecurity During and After Campus Shut Down

Multivariate logistic regression was conducted to identify independent predictors of food insecurity during and after campus shut shown (Table 9). Impact of COVID-19 on employment, receipt of emergency funding, and immigration status were all statistically significant independent predictors of food insecurity after controlling for gender and academic standing of the students. Participants who reported that the COVID-19 pandemic impacted their employment status were at greater risk for food insecurity compared to participants who reported no change in employment status due to the pandemic. Participants who reported COVID impacting their employment during campus shut down had 1.83 times greater odds (95% CI: 1.24, 2.69; p = .002) of being food insecure compared to their counterparts who reported their employment was not impacted by COVID. Additionally, participants who reported COVID impacting their employment status after campus shut down had 5.10 times greater odds (95% CI: 2.56, 10.13; p < .000) of being food insecure, and those who reported COVID impacting their employment status both during and after campus shut down had 4.28 times greater odds (95% CI: 2.96, 6.19; p value<.0001) of being food insecure compared to those whose employment was not impacted by COVID (Table 9).

Moreover, receipt of emergency funding, such as the HEER grant, was an independent predictor of food insecurity. Compared to students who did not receive emergency funding, students who received funding were at an increased odds of being food insecure. Participants who received emergency funding during campus shut down had 2.74 times greater odds (95% CI: 1.99, 3.75; p < .0001) of being food insecure. Participants who received emergency funding after campus shut down had 2.07 times greater odds (95% CI: 1.55, 2.76; p < .0001) of being food insecure (Table 9).

Finally, immigration status was an independent predictor of food insecurity. Both during and after campus shut down, international students were at greater odds of being food insecure compared to domestic students. During campus shut down, international students had 2.47 times greater odds (95% CI: 1.41, 4.30; $p = .001$) of being food insecure, and after campus shut down, they had 2.07 times greater odds (95% CI: 1.55, 2.76; $p < .0001$) of being food insecure compared to domestic students (Table 9).

Table 9. Multivariate Logistic Regression of Predictors of Food Insecurity During and After Campus Shut Down.

	During Campus Shut Down[1]				After Campus Shut Down[2]			
Exposure Variables	n	Odds Ratio	95% CI	p- value	n	Odds Ratio	95% CI	p- value
COVID Impact on Employment								
Yes, during shut down	169	1.83	1.24, 2.69	.002	37	5.10	2.56, 10.13	<.0001
Yes, after shut down					146	4.29	2.96, 6.19	<.0001
Both during and after campus shut down					957	1		
No Impact	957	1						
Pre-Existing Health Condition Status								
Yes	236	1.35	0.96, 1.88	0.085	236	1.27	0.92, 1.74	.142
No	1073	1			1073	1		
Immigration Status								
International student	68	2.47	1.41, 4.30	.001	68	1.82	1.04, 3.17	.034
Domestic student	1241	1			1241	1		
Receipt of Emergency Funding								
Yes	253	2.74	1.99, 3.75	<.0001	300	2.07	1.55, 2.76	<.0001
No	1056	1			1009	1		

[1] Hosmer and Lemeshow Test **During** Campus Shut Down chi square = 8.69, p-value = .276
[2] Hosmer and Lemeshow Test **After** Campus Shut Down chi square = 6.70, p-value = .460

Table 10. Multivariate Logistic Regression of Predictors of Dietary Diversity During and After Campus Shut Down.

	During Campus Shut Down[1]				After Campus Shut Down[2]			
Exposure Variables	n	Odds Ratio	95% CI	p- value	n	Odds Ratio	95% CI	p- value
COVID Impact on Employment								
Yes, during shut down	169	0.74	0.52, 1.03	.076				
Yes, after shut down					37	0.72	0.36, 1.42	.344
Both during and after campus shut down					146	.82	.56, 1.18	.287
No Impact	955	1			955	1		
Pre-Existing Health Condition Status								
Yes	236	0.82	0.61, 1.10	.188	236	0.11	0.79, 1.48	.593
No	1071	1			1070	1		
Immigration Status								
International student	67	0.75	0.42, 1.30	.309	68	0.99	0.55, 1.76	.964
Domestic student	1240	1			1238	1		
Receipt of Emergency Funding								
Yes	253	0.56	0.41, 0.75	<.0001	299	0.68	0.51, 0.90	.008
No	1054	1			1007	1		
Race / Ethnicity								
White	992	1			990	1		
Black / African American	90	0.75	0.47, 1.16	.201	90	0.79	0.49, 1.24	.308
Other[3]	225	1.10	0.79, 1.51	.563	226	1.02	0.73, 1.41	.905
Food Security Status During Shut Down								
Food secure	999	2.96	2.23, 3.92	<.0001	915	2.55	1.96, 3.29	<.0001
Food insecure	308	1			391	1		

[1] Hosmer and Lemeshow Test **During** Campus Shut Down chi square = 5.15, p-value = .741
[2] Hosmer and Lemeshow Test **After** Campus Shut Down chi square = 7.19, p-value = .515
[3] Includes American Indian, Native Alaskan, Asian, Hispanic and Latino, Native Hawaiian, and Pacific Islander.

3.3.7 Predictors of Dietary Diversity During and After Campus Shut Down

Multivariate logistic regression was conducted to identify independent predictors of dietary diversity during and after campus shut shown (Table 10). Both receipt of emergency funding and food security status were statistically significant predictors of dietary diversity, after controlling for gender and academic standing. Participants' receipt of emergency funding, such as the HEER grant, was an independent predictor of low dietary diversity. These findings were statistically significant for both during and after campus shut down. During campus shut down, students who received funding had 56% lower odds (95% CI: 0.41, 0.75; $p < .0001$) of eating a diverse diet and after campus shut down, the odds of consuming a diverse diet was 68% (95% CI: 0.51, 0.90; $p = .008$) lower compared to those who received no emergency funding (Table 10). Furthermore, food security status was an independent predictor of high dietary diversity both during and after campus shut down. During campus shut down, food secure participants had 2.96 times greater odds (95% CI: 2.23, 3.92; $p < .0001$) of eating a diverse diet, and the odds were 2.55 (95% CI: 1.96, 3.29; $p < .000$) after campus shut down for consuming a diverse diet compared to food insecure participants (Table 10).

3.4 Discussion

This study examined the burden and determinants of food insecurity among college students during and after campus shutdown due to the COVID-19 pandemic. The findings show that food insecurity increased after campus shut down, while overall dietary diversity improved. Interestingly, a higher number of participants received relief funding after campus shut down compared to during shut down. Moreover, the results reveal that participants increased their physical activity and structured workouts after campus shut down.

The excepted results of this study were that food insecurity among college students would decrease due to increased relief funds available for college students after campus shut down, however, the findings reveal the opposite. Food insecurity increased after campus shut down, likely due to the economic ramifications of the pandemic on college students' finances. According to the Center on Budget and Policy Priorities, COVID-19 affected the economy by causing supply chain issues that contributed to increased prices for goods (Center on Budget and Policy Priorities, 2022). Pulse Survey data from October 2021 reveals that 20 million American adults reported not getting enough food to eat and 12 million adults reported being behind in rent payments. The survey reports that 82% of respondents indicated that they did not get enough to eat because they could not afford it, as opposed to other factors, like safety concerns or lack of transportation (Center on Budget and Policy Priorities, 2022). In Georgia, 23% of adults were not caught up on rent payments and may have accumulated additional debt from months of back rent and late fees, especially among those whose employment was impacted by COVID (Center on Budget and Policy Priorities, 2022).

Food insecurity among college students increased following campus shut down, despite more students receiving relief funds. NASFAA survey data revealed the top single uses of emergency funds among college students were paying past due balances, textbooks, and upcoming tuition (National Association of Student Financial Aid Administrators, 2022). After paying for these necessities and catching up on rent payments, there may not be enough money left to purchase adequate amounts of food. According to NASFAA, 39% of students reported the amount of emergency funding received was not adequate to meet their needs (National Association of Student Financial Aid Administrators, 2022). Moreover, NASFAA reports four in ten students used higher education emergency relief funds for transportation, and about one third used these funds for upcoming tuition, technology devices, internet service, or utilities (National Association of Student Financial Aid Administrators, 2022).

In the multivariate logistic regression analysis, independent predictors of food insecurity were COVID's impact on employment status, receipt of emergency funding, and immigration status. If COVID impacted the participant's employment status either during or after shut down, the participant was more likely to be food insecure. This makes logical sense, as less income would result in less money available to purchase food besides paying for other critical expenses. Furthermore, participants who reported receiving emergency funding, such as the HEER grant, were more likely to be food insecure. As mentioned previously, this finding suggests that participants may have used that money towards other necessities, like rent, books, past due balances, medical expenses, phone, or car payments, etc. These funds were provided to eligible students, with the highest amounts being awarded to Pell Grant recipients (US Department of Education, 2022) who fall below the federal poverty level. Participants who identified as recipients of emergency funding were likely students who were of low socioeconomic status, as

federal grants are awarded to students who have exceptional financial needs (US Department of Education, 2022). Due to these students' low socioeconomic status, it is likely that these students may be falling behind on rent payments and/or unable to afford their usual expenses, therefore channeling funds towards these payments instead of food, which would explain why receipt of emergency funding is associated with students' odds of being food insecure. However, it is important to note that this may be speculative because this study did not collect specific information about the participants' socioeconomic status. Lastly, international students were at a higher odds of being food insecure during and after campus shut down. This is in line with previous research, as a 2021 review by Shi and colleagues reported that international students were more vulnerable to food insecurity compared to domestic students (Shi et al, 2021). In their review, Shi and colleagues report that out of seven studies reviewed, six reported higher percentages of food insecurity among international students compared to their domestic peers (Shi et al, 2021). International students often pay higher tuition than domestic students and have less access to student loans and other forms of financial assistance from governments and universities, and are mostly unable to work, which puts them at an increased risk of experiencing food insecurity (Shi et al, 2021).

Although it is well documented in the current literature that food security and dietary diversity are directly correlated (Antwi et al, 2022; McDonald et al, 2015; Abou-Rizk et al, 2021; Wang et al, 2017; Rivera et al, 2019), findings from the current study show that dietary diversity improved after campus shut down despite lower levels of food security. However, food security was a statistically significant independent predictor of higher dietary diversity. In the current study, participants had a higher likelihood of consuming diverse diet if they were food secure. In addition to food security status, receipt of emergency funding was an independent predictor of

low diversity in the diet. If participants reported receiving emergency funding, they had a higher likelihood of consuming a diet that has low diversity. Receipt of emergency funding was an independent predictor for both food insecurity and lower dietary diversity. Relief funds are awarded to those who are in exceptional financial need. This indicates that those who receive emergency funding, such as the HEER grant, are likely of low socioeconomic status and these students already experience higher levels of food insecurity and lower levels of dietary diversity. In conjunction with the worsening economy, the present amount of funds received does not make any significant impact on their food security status and diversity of their diet. It has been reported in previous research studies that people of low socioeconomic status suffer increased levels of food insecurity and decreased diversity in their diets (Rivera et al, 2019).

Findings from the current study reveal that physical activity and structured workouts increased after campus shut down. With the onset of the COVID-19 quarantine period and campus-wide shut down, significant lifestyle changes occurred (Sidebottom et al, 2021). Classes moved to online platforms, such as Zoom, naturally increasing sedentary behavior among students. Additionally, university facilities closed during campus shut down, leaving students with no access to recreational centers, dining halls, etc., further contributing to increases in sedentary behaviors. After campus shut down, classes moved back to hybrid, or in-person formats and university recreational centers were able to open back up. This points towards students' increased ability to engage in structured workouts at the university gym again, as well as increases in their physical activity in several other ways, including running, jogging, walking or biking to class or the dining halls. It is important to note that the survey questions were subjective in nature, as physical activity may entail different things to different participants.

Furthermore, their perceived level of activity may vary from how much activity they truly got during these time periods.

Our study makes novel contributions to the current literature on food insecurity among college students especially during and after campus shut down, however, as with any research, it comes with certain limitations. Survey fatigue among participants is a limitation that exists within any survey-based research, especially online survey. To mitigate the potential impact of this, the instrument was concise, only targeting necessary details. Additionally, there was no incentive for participants. This may have caused less students to be willing to participate affecting the representativeness of our participants, however, the students' who chose to participate likely provided truthful responses, as they were not motivated by monetary factors, but rather intrinsic factors such as a genuine willingness to contribute to research.

Most participants were white, male, domestic students, which limits the generalizability of our results. However, our study population demographics are similar to the UGA student body, including both undergraduate and graduate students. Student population at UGA is 66.7% White and 8.22% Black or African American, while our study population was 73.7% white and 7.8% black (Data USA, 2022). One difference is that our study participants were majority (69.5%) males, while UGA study body is majority (51.3%) females. The current literature regarding survey response rates indicates that young, affluent, technologically literate males are more likely to respond to web-based surveys (Palmquist and Stueve, 1996; Sax et al, 2003; Kwak et al, 2002). This is important to note, as males are often overrepresented in online survey research. Furthermore, our findings are not necessarily generalizable to all universities across the United States, as the national demographics differ from our study population. Nationally, 54.1%

of college students are white, and 13.1% are black or African American, and approximately 60% are female, while less than half are male (Welding, 2022).

A major strength of this study is the innovative contribution it makes to the current knowledge on food insecurity as it pertains to the impact of COVID-19 shut down on university students. Prior to our study, a gap in the scientific literature existed, as there were no studies which have examined the impact of campus-wide shut down during the pandemic (March 2020 – July 2020), and the re-opening of campus after the height of the pandemic (August 2020 – present). The current study establishes the impact of COVID-19 on food security during and after campus shutdown. Our study provides a differentiation of specific stages within the pandemic and offers unique insight into the burdens and determinants of food insecurity during these unprecedented times among students on a university campus. The results may aid university authorities and government agencies in better understanding and preparing for future natural disaster events.

With regards to future directions, food insecurity and mental health is an interesting and important realm for researchers to explore further. Our study did not focus on mental health, but it is known that interplay exists between mental wellbeing and food security status (Yenerall et al, 2021). The COVID-19 lock down period had profound and lasting impacts on the mental health of college students (Son et al, 2020; Li et al, 2021; Wood et al, 2022). Due to this, further research should be done to explore the relationship between mental health factors and food insecurity within the specific stages of the pandemic.

One of our major findings was that participants were more likely to be food insecure if they reported receiving emergency funding. More research should be done to explore how this happened. Perhaps additional funding, specifically designated for the purchase of food, could be

made available for low-income students during natural disaster/emergency events in the future. Furthermore, information and access to SNAP benefits should be made more widely available for college students, as the GAO reports that almost 2 million at-risk college students did not receive SNAP benefits, despite being potentially eligible (GAO, 2018).

Implications of the current study include worsening physical and mental health outcomes among food insecure college students. It is well documented in the current literature that food insecurity is associated with a number of chronic diseases, such as obesity, type II diabetes, and cardiovascular disease, as well as adverse mental health effects, such as depression, anxiety, and stress (Thomas et al, 2021; Hawkins et al, 2021). Studies have shown that food insecure students have lower GPAs and higher proportions of poor mental health indicators when compared to food secure students (Martinez, 2020). This illustrates that these students are not only at a disadvantage with regards to finances, but also academic performance, career outcomes, health, and well-being.

In conclusion, the results of the current study reveal the influence of COVID-19 on food security status during and after campus shut down. The findings show that food insecurity increased, overall dietary diversity improved, physical activity and structured workouts increased, and a higher number of participants received emergency funding after campus shut down compared to during shut down. These results provide useful insights for universities, government agencies, and policymakers on ways to combat food insecurity on college campuses in future emergency situations.

Overall, this process was eye-opening, as it showed me what it takes to be a researcher and to see a research project from conception to completion. I learned how to effectively search scientific literature, formulate a research question with specific aims, use validated measures to

ensure accurate survey results, analyze data, and make sense of results that were contrary to my original hypothesis. I feel like I have grown throughout this process, and I now possess the critical thinking and problem-solving skills that are necessary to perform exceptional research in my chosen field. If I could go back in time and do this project again knowing what I know now, I would allot more time for data analysis. This was the most challenging part for me due to the time constraints. I would advise future researchers interested in this type of research to spend plenty of time searching the current literature on the topic before jumping in to conducting their own study. This helped me greatly and allowed me to find gaps and nuances in the scientific literature that ultimately helped lead to my research questions and the measures utilized. Working on this study over the past two years has been a challenging process with many ups and downs, but it shaped me into the nutrition professional that I am today and for that I am extremely grateful. I know these skills will serve as valuable assets to me in any career path I choose to take.

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CHAPTER FOUR

CONCLUSIONS AND IMPLICATIONS

The results of this study reveal the impact of the COVID-19 pandemic on the food security status of college students during and after campus shut down. The findings show that food insecurity increased among college students after campus shut down, while their overall dietary diversity improved. Additionally, a higher number of participants received emergency funding after campus shut down compared to during shut down and participants increased their physical activity/ structured workouts after campus shut down.

The increase in food insecurity observed in this study after campus shut down, is likely due to the economic ramifications of the pandemic including supply chain issues that contributed to increased prices for goods including food, and additional debt from months of back rent and late fees, especially among those whose employment was impacted by COVID (Center on Budget and Policy Priorities, 2022). Contrary to our hypothesis, receipt of emergency funding was associated with increased odds of being food insecure. These funds are distributed to individuals in exceptional financial need, so it is likely that these students may be falling behind on rent payments and/or unable to afford their usual expenses, therefore channeling funds received towards these payments instead of food. Interestingly, dietary diversity improved after campus shut down despite lower levels of food security, however, these results were not statistically significant. Conversely, participants had a higher likelihood of consuming a diverse diet if they were food secure, and these results were statistically significant.

Finally, physical activity increased after shutdown, likely due to the re-opening of recreational centers, and students walking or biking to classes, dining halls, etc. With the onset of the COVID-19 quarantine period and campus-wide shut down, significant lifestyle changes occurred, such as classes moving to online platforms which naturally increased students' sedentary behaviors. After campus shut down, classes moved back to hybrid, or in-person formats and university recreational centers were able to open back up, increasing students' physical activity levels.

Most participants in our study were white, male, domestic students. The current literature regarding survey response rates indicates that young, affluent, technologically literate males are more likely to respond to web-based surveys (Palmquist and Stueve, 1996; Sax et al, 2003; Kwak et al, 2002). This is important to note, as males are often overrepresented in online survey research, therefore limiting the generalizability of these results. However, our study population demographics are similar to the UGA student body, including both undergraduate and graduate students. Student population at UGA is 66.7% White and 8.22% Black or African American, while our study population was 73.7% white and 7.8% black (Data USA, 2022). Lastly, our findings are not necessarily generalizable to all universities across the United States, as the national demographics of college students differ from our study population. Nationally, 54.1% of college students are white, and 13.1% are black or African American, and approximately 60% are female, while less than half are male (Welding, 2022).

Implications include poor physical and mental health outcomes among food insecure college students, per previous research studies. It is well documented in the current literature that food insecurity is associated with a number of chronic diseases, such as obesity, type II diabetes, and cardiovascular disease, as well as adverse mental health effects, such as depression, anxiety,

and stress (Thomas et al, 2021; Hawkins et al, 2021). Studies have shown that food insecure students have lower GPAs and higher proportions of poor mental health indicators when compared to food secure students (Martinez et al, 2020). This illustrates that these students are not only at a disadvantage with regards to finances, but also academic performance, career outcomes, health, and well-being.

Prior to our study, a gap in the scientific literature existed, as there were no studies which have examined the impact of campus-wide shut down during the pandemic (March 2020 – July 2020), and the re-opening of campus after the height of the pandemic (August 2020 – present). The current study documents the impact of COVID-19 on food security during and after campus shutdown. The findings show that food insecurity increased, overall dietary diversity improved, physical activity and structured workouts increased, and a higher number of participants received emergency funding after campus shut down compared to during shut down. These results provide useful insights for universities, government agencies, and policymakers on ways to combat food insecurity on college campuses in future emergency situations.

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