

**THE IMPACT OF FOOD INSECURITY ON MENTAL HEALTH,
PHYSICAL HEALTH AND WELLBEING IN LOW-INCOME SENIORS
DURING THE COVID-19 PANDEMIC**

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Abstract

Background: Adequate food and nutrition are vital components of human wellbeing, which are compromised by food insecurity in many low-income populations, especially during the COVID-19 pandemic. Measuring the impact of the pandemic on the overall health and wellbeing of food insecure older adults is crucial to lower the burden of food insecurity and further senior wellbeing during this challenging time.

Aims: The primary aims of this research study are to assess the impact of food insecurity on physical health, mental health, and social wellbeing among low-income participants during the COVID-19 pandemic, comparing 2 study groups among the study sample. While Heritage residents have been receiving free grocery deliveries during the pandemic, Plaza Tower residents have not.

Methods: The study consists of a survey with 4 sections related to COVID-19, mental health, physical health, and emotional wellbeing during the pandemic, as well as an optional follow-up interview to further discuss personal experiences related to food insecurity and/or health. SPSS software was used for data analysis.

Results: Overall, Plaza Tower residents experienced a greater decline in all health and wellbeing measures compared to Heritage residents. Heritage residents had significantly lower scores for “health status in terms of diet and nutrition” and “social network” compared to Plaza Tower residents. Heritage residents also reported “unintentional weight loss” and “trouble staying full between meals” more often than the Plaza Tower group. The number of individuals living in the household of residents was significantly associated with “feeling lonely and isolated from others”.

Discussion: While Heritage residents on average reported lower scores for health measures before the pandemic compared to Plaza Tower residents, the gap between the two study groups narrowed during the pandemic, possibly due to the food deliveries that Heritage residents have been receiving. Plaza Tower residents also reported greater overall decline in health measures during the pandemic compared to Heritage residents, pointing to higher vulnerability.

Implications: Studying this vulnerable population is significant as it can help identify certain health measures or markers related to food insecurity, and alleviate food insecurity while improving both physical and mental health in the long term.

Introduction

Food insecurity is a rampant public health problem, impacting multiple dimensions of health and wellbeing (Hadley, 2012). With the COVID-19 pandemic, additional challenges have emerged surrounding food insecurity that disproportionately affect certain populations, including low-income older adults. As previous research has shown, food insecurity is closely linked to physical health and mental health status, which may have been exacerbated due to recent global events (Hartline-Grafton, 2019; Ziliak, 2020; Perez-Zepeda, 2016; Malek Rivan, 2021; Maynard, 2018; Pourmotabbed, 2020; Weaver, 2009; Wolfson, 2020). Low-income seniors are among the most vulnerable people in our society, who have been experiencing social isolation and changes to their daily routine due to the COVID-19 pandemic (“Social”, 2019). Novel food rescue programs have arisen as potential solutions for alleviating food insecurity, but few studies have characterized the impacts of food rescue programs upon beneficiaries and overall health of individuals. Since food and nutrition are such vital components of human wellbeing, measuring the impact of COVID-19 on food insecurity in this population and the potential role that food rescue organizations can play in lowering the burden of food insecurity is important to further low-income senior wellbeing during this challenging time. This study aims to explore the impact of COVID-19 on low-income seniors in terms of food insecurity, mental health, physical health and wellbeing. This study also aims to evaluate the impact of a food rescue program that has been implemented in a senior community in the Bay Area to assess how the program can play a role in improving wellbeing, especially during the COVID-19 pandemic. While the Bay Area houses incredible resources in terms of job growth and income, there is also incredible poverty due to significant income gaps among residents. Thus, the Bay Area might be a prime focus for food rescue programs to target and impact the low-income population. The results of this study

will help us better understand the changing needs of low-income, food insecure seniors during this unique time and potentially tailor services to improve health and wellbeing in this population.

This research study was conducted alongside Komal Kumar, whose thesis is focusing on the impact of social isolation due to shelter-in-place restrictions during COVID-19 and its relationship to mental health. Understanding the overall picture of the impact of the pandemic on the low-income senior population, primarily focusing on the impact of food insecurity and isolation, is critical to target gaps in research and enhance wellbeing in a challenging time for a vulnerable population.

Literature Review

I. The State of Food Insecurity in the U.S.

Food insecurity, defined by the U.S. Department of Agriculture (USDA) as a household-level economic and social condition of limited or uncertain access to adequate food, is a rampant problem that impacts health and wellbeing, especially for older adults (Coleman-Jensen, 2020a). USDA categorizes food insecurity into low and very low food security, which represent reduced quality, variety, and desirability of diet, as well as disrupted eating patterns and reduced food intake. According to a 2019 Population Survey by the USDA, 10.5% of U.S. Households were food insecure, with 6.4% categorized as households with low food security and 4.1% categorized as households with very low food security (Coleman-Jensen, 2020b). These households reported that they were not able to obtain enough food for each member of the household due to lack of money or other resources. Compared to food-secure households, food insecure households reported to have higher rates of worrying that food would run out, food bought would not last, they can't afford balanced meals, need to cut meal sizes or skip meals, eat less than they should, are hungry but not eating, and losing weight (Coleman-Jensen, 2020a). This survey also identified that 7.2% of households with older adults were food insecure, as well as 8.7% of older adults living alone and 19.1% of women living alone.

While food insecurity affects all ages, older adults are a particularly vulnerable population due to certain challenges caused by aging and are more likely to remain food insecure while experiencing greater health effects (Buys, 2015). A 2018 report by Feeding America stated that approximately 5.3 million older adults were food insecure, experiencing food insecurity, reduced-portion or skipped meals, difficulty paying meals, medication cut-backs and

dissatisfaction with finances (Baker-Lutz, 2020). Compared to children and adults, older adults with limited resources are at higher risk to experience long-term poverty and food insecurity, due to lower ability to seek out new resources (Buys, 2015). The progression of senior food insecurity starts with an altered and compromised diet, followed by food supply anxiety, “socially unacceptable” meals, use of emergency food strategies, and finally hunger (Wolfe, 1998).

Certain groups of older adults are reported to be disproportionately impacted by food insecurity, including those who are low income, have less education, are African American or Hispanic, separated or divorced, living alone, or living with a disability (Baker-Lutz, 2020; Hartline-Grafton, 2019). A 2018 retrospective cohort study also revealed that the prevalence of food insecurity was almost 10% higher for those who were African American or Hispanic, had less than high school education, Medicaid insurance, poor health status, depression or anxiety, impairments in certain activities of daily living, nutritional risk factors or were socially isolated (Steiner, 2018). Having ownership of the house/apartment being resided in is also a factor that impacts food security, where households that rent their house/apartments are reported to experience significantly higher levels of food insecurity, especially during the COVID-19 pandemic (Morales, 2020).

There are numerous reports of racial/ethnic disparities in food security status, which has undoubtedly increased since the COVID-19 pandemic that disproportionately impacted people of color, who are already at higher risk of experiencing social/economic hardships and racial discrimination (Wolfson, 2020). A cross-sectional study on household food insecurity during the COVID-19 pandemic reported that racial/ethnic minorities were significantly less confident regarding their food security in the next four weeks, compared to Whites. Among food-insecure

households, African American households more frequently reported that they could not afford to purchase more food, Asian and Hispanic households more frequently reported that they were afraid to go out to purchase food, and Asian households more frequently reported that they experienced transportation problems when going out to purchase food (Morales, 2020). Racial/ethnic disparities related to food insecurity cannot be overlooked as certain populations are more vulnerable compared to others and may need further protection and assistance.

II. *Food Insecurity & Physical Health*

A healthy, balanced, and nutritious diet is significant for health and wellbeing all throughout the lifespan. There are several known risk factors linked to inadequate nutrition intake such as race, poverty, living alone, presence of chronic diseases, cognitive functioning, location of residence and household food sufficiency (Buys, 2015). A poor diet can cause nutritional deficiencies that lead to increased risk of disease and worsening of chronic conditions, especially for the aging population. Older adults are 84% more likely to have at least one chronic health condition such as diabetes or heart disease, which also put them at higher risk for morbidity or mortality due to COVID-19 (Goger, 2020). Food insecure older adults disrupt their dietary intake to consume fewer calories or choose cheap but unhealthy options, and in turn impact their physical health in ways that put them at additional risk compared to other individuals. Poor physical health status can in turn impact the ability to purchase and prepare food, such as having difficulties with carrying, bending or shortness of breath during food shopping (Russell, 2016). A national study evaluating the diet of food insecure older adults reported an overall decreased quality in diet and nutrition intake in this population, compared to food secure older adults (Hartline-Grafton, 2019). The food insecure individuals consumed less

calories, protein, essential vitamins, calcium, phosphorus, iron and magnesium, which can lead to an array of health deficiencies, such as hair loss (Guo, 2017; Hartline-Grafton, 2019). There is a strong association between food insecurity and poor health outcomes, especially for diet-related issues. Older adults who are food insecure are 19% more likely to suffer from high blood pressure, 57% more likely to suffer from congestive heart failure, 65% more likely to suffer from diabetes, and 66% more likely to experience a heart attack (Ziliak, 2020). Additionally, food insecurity can lead to diet-related frailty that increases the risk of falls, which is the leading cause of injuries for older adults (Bergen, 2016). Another study found that the healthier the respondents reported they were, the more food secure their households were (Morales, 2020). Thus, diet is especially critical for older adults in terms of their physical health status, where food insecurity has a direct relationship with poor physical health.

Food insecurity is associated with low food expenditure, low fruit and vegetable consumption and a less healthy diet overall (Drewnowski, 2004). There are several physical symptoms that point to an unhealthy or inadequate diet that can also be related to food security status, such as fluctuations in weight. For instance, a study reported weight loss and falls in food insecure patients due to reduction in food quantity and quality (Seligman, 2017). Conversely, another study reported that food insecure adults were 32% more likely to be obese compared to food secure adults (Pan, 2012). This could be due to food insecure individuals consuming higher amounts of food when it is available and thus causing greater food intake, or the cheaper food options usually being energy-dense yet nutrient-deficient, where they are especially high in fat and sugar. There are also reports of high rates of binge-eating disorder and obesity in low and very low food secure individuals, caused by patterns of restriction and over-eating (Rasmusson, 2019).

While physical functioning abilities are significant for older adults, food insecurity can put this population at higher risk to have limitations in daily activities (Pooler, 2019). A survey-based study on food insecurity and physical functioning limitations among U.S. seniors evaluates this phenomenon. The report stated that older adults with 4 or more physical limitations were more likely to report very low food security, compared to older adults without physical limitations, in a dose-response relationship (Jackson, 2019). A Mexican nationwide survey examined the relationship between food insecurity and frailty, which is a condition that puts older adults at higher vulnerability for adverse outcomes and mortality. This survey found that food insecure participants were associated with frailty, where the more severe food insecurity categories had a higher association (Perez-Zepeda, 2016). The findings from these studies suggest that food security status acts as both a predictor and an outcome of poor health and wellbeing.

According to a 2014 report on food insecurity in older adults, food insecurity has been linked to several health conditions such as hypertension, hyperlipidemia and diabetes. In fact, food insecure individuals are at double the risk of suffering from diabetes compared to food secure individuals (Buys, 2015). Furthermore, food insecurity increases the likelihood of malnutrition and undernutrition, which can contribute to obesity and is associated with ulcers, hip fractures, falls, weakness, fatigue, anemia, edema, cognitive dysfunction, infections, immune system dysfunction and decreased response to immunizations (Buys, 2015). Malnutrition also has clinical signs including brittle nails and white marks on nails that can help identify at-risk individuals (DiBaise, 2019; Patel, 2016). Recent reports have suggested a higher risk of SARS-CoV-2 infection among those who experience malnutrition, as well as more severe sickness resulting in hospitalization (Huizar, 2021).

III. Food Insecurity & Mental Health

While food insecurity has well known impacts on physical health, it is also significantly associated with mental health and emotional wellbeing, especially with novel stressors during the COVID-19 pandemic. Food has both a biological and social role that cannot be overlooked when assessing the relationship between food insecurity, physical health and mental health. Not having adequate access to or availability of a food supply can cause increased stress, feelings of uncertainty and hopelessness that can contribute to poor mental health. There are a number of reports and studies that state the relationship between food insecurity and increased stress, depression, and anxiety (Malek Rivan, 2021; Maynard, 2018; Pourmotabbed, 2020; Weaver, 2009). In terms of the role of nutrient deficiency and poor diet in older adults, a recent study found a significant association between food insecurity, low levels of protein and fiber, and psychological distress (Malek Rivan, 2021). With the COVID-19 pandemic increasing food insecurity severity and prevalence, older adults are now more vulnerable than ever in terms of both their physical and psychological health and wellbeing.

Food insecurity remains a continuing issue in high-income countries, and has been increasingly associated with poor mental health, including mood and anxiety disorders, and suicidal ideation (Maynard, 2018). In fact, food insecurity acts as a marker of poor mental health in a dose-response relationship, and is more pronounced in women. Survey data collected from 160 countries revealed that when prevalence of food insecurity is lower, relative food insecurity is more strongly associated with mental health and wellbeing (Elgar, 2021). This survey, based on national and international study groups, also stated that food insecurity is significantly related to lower positive wellbeing and lower life satisfaction, after controlling for household income and country-specific differences. A similar cross-sectional study with data from 149 countries

also reported the dose-response relationship between food insecurity and poorer mental health status, supporting the cross-cultural relevance and consistency of this relationship (Jones, 2017).

Another review report stated that the main themes identified related to food insecurity were an experience of acute psychological suffering, an anxious/stressful/shameful experience, and an embodied experience where the incident was so severe that participants reported feeling physical symptoms (Weaver, 2009). The disparities in socioeconomic status and social acceptance among food security levels might further contribute to poor mental health and cause feelings of alienation, powerlessness and guilt (Pourmotabbed, 2020). The results point to a clear association between food insecurity and symptoms of common mental disorders, as well as increased vulnerability to poor physical and mental health overall.

The association between food insecurity, nutritional intake and depression has been further analyzed among older adults in a 2017 cross-sectional study. The results reveal that functionally impaired low-income seniors experience more severe food insecurity, and both the inability to purchase more food and limited self-care capacity contributes to reports of increased depression-related symptoms (Jung, 2019). Food insecure older adults who experience anxiety about food supply, hunger and are forced to cut down portion sizes or skip meals, are less likely to have access to helpful resources to support their mental health and wellbeing in the first place. This causes a cyclical process of food insecurity symptoms, poor physical health and poor mental health that interferes with many dimensions of wellbeing and functioning.

The COVID-19 pandemic has posed a great threat on the mental health and wellbeing of food insecure older adults, due to long-term shelter-in-place restrictions and social distancing measures. While these regulations are highly critical to reduce and prevent the spread of COVID-19, it inevitably leads to social isolation, loneliness, and further negative mental health

consequences for older adults. Many research studies have shown that social isolation and loneliness leads to a higher risk for physical and mental health problems, including high blood pressure, heart disease, obesity, weak immune system, anxiety, depression, cognitive decline, and even death (“Social”, 2019). Those who are particularly vulnerable include those experiencing the death of a spouse/partner, separation from friends and family, retirement/unemployment, loss of mobility and physical functioning. The COVID-19 pandemic has certainly led to these situations for many individuals over the last year, specifically for older adults who are at heightened risk for the virus and thus need the most protection. A study assessing the role of loneliness and social support among food insecure older adults reported that both loneliness and lack of social support were significantly associated with a higher risk of food insecurity (Burris, 2021). Furthermore, older adults are more likely to face daily challenges related to social and physical isolation, such as diseases or conditions that limit mobility, inability to walk or drive, and limited income. A public policy report analyzing Medicare spending data reported that each month, Medicare spends about \$134 more for each socially isolated older adult than it would if the person was connected to social contacts (Flowers, 2017). Additional spending for this population was due to certain chronic conditions such as arthritis, high blood pressure, heart disease and diabetes, which are all related to food insecurity as well. Isolation and social connectedness are critical pieces that play a role in the overall mental health and wellbeing of older adults who are experiencing food insecurity during COVID-19.

IV. Impact of COVID-19 on Food Insecurity

Food insecurity alone leads to many negative health outcomes and a reduction in quality of life in terms of physical health, mental health and wellbeing. These negative outcomes have mostly been exacerbated with the COVID-19 pandemic (Wolfson, 2020). Since February 2020, the pandemic has caused a global disruption in all dimensions of society, including health and wellbeing, due to reduced access to food and a disruption in food systems overall. Global efforts to reduce COVID-19 infection rates have caused numerous downstream effects on economic markets, in terms of producing, processing, transporting and exporting food supply (Huizar, 2021).

A cross-sectional national study revealed that while 30% of their sample self-reported as being food insecure in early March 2020, this rate increased to 43% by late April 2020 (Morales, 2020). Older adults who were already experiencing food insecurity faced additional challenges to navigate their new lives, in terms of protection from severe illness or death, isolation due the shelter-at-home restrictions, unemployment and lack of access to food resources. In April 2020, the U.S. unemployment rate increased to 14.8%, a record high, which has undoubtedly contributed to food insecurity as well (Falk, 2021). A survey-based U.S. study from April 2020 on the early impact of COVID-19 on food insecurity reported a 32% increase in household food insecurity since the pandemic started, where almost 36% of the households were newly food insecure (Niles, 2020). This study also reported that unemployed individuals were at higher risk of experiencing food insecurity, as well as other physical and economic challenges. Another web-based national study from March 2020 on the disparities in early effects of COVID-19 on food insecure U.S. adults reported that for households that are already categorized as low-

income, loss of income caused a high risk of severe food insecurity and a lack of access to basic human needs, which can lead to many physical and mental health challenges (Wolfson, 2020).

Food insecurity is directly related to increased healthcare costs, with food-insecure individuals experiencing more severe chronic health conditions (Wolfson, 2020). With the pandemic reducing access to food for these individuals, there may be a tradeoff between medicine and food, leading to medication nonadherence and an increase in morbidity and mortality (Leddy, 2020). Other changes to daily routine included social distancing measures and grocery stores closing or adjusting their hours to account for new regulations, leaving many older adults on their own to find reliable access to food. Many senior homes closed for visitation, separating the residents from their families and support systems, further contributing to social isolation. With the increasingly aging population, COVID-19 has been a significant disturbance to the relatively decreasing older adult food insecurity trend since 2013, and it is projected that food insecurity levels will greatly increase in the upcoming years. (Baker-Lutz, 2020)

V. *Food Assistance and Rescue Programs*

Food insecurity is a critical problem that needs a substantial public health response, especially for the aging population. In fact, it is projected that by 2030, the population of individuals who are 65 years and older in the U.S. will surpass 72 million, which calls for further action to improve services and resources for low-income older adults (Buys, 2015). There are two aspects to food security- food access and food recovery (Schumacher, 2019). Food access can be impacted by the social and economic challenges in a community, as well as personal barriers regarding income or ability to shop for and prepare food, due to transportation or other limiting health issues. Food recovery, on the other hand, indicates the collection of food from

either farmers directly, or institutions such as grocery stores and food distributors, to be donated to populations in need through various strategies and efforts. This process usually requires a collective community effort and coordination and can be instrumental in reducing food waste and hunger.

Studies reveal a significant association between food insecurity and participation in food assistance/rescue programs, as food insecure individuals tend to rely more on free meals and groceries. A nationally representative survey reported that households receiving free meals or groceries during the past week were significantly more food insecure than households that did not receive anything (Morales, 2020). A nationally representative longitudinal study also reported that older adults with higher food insecurity levels had higher rates of participation in food assistance programs (Kim, 2009). Thus, individuals taking part in food rescue programs are the ones that need food assistance the most.

There are numerous food nutrition programs available for low-income older adults such as the Supplemental Nutrition Assistance Program (SNAP), Congregate Nutrition Program, Emergency Food Assistance Program, Home-Delivered Nutrition Program for frail, homebound or isolated older adults, Commodity Supplemental Food Program for older adults who are eligible in terms of their income, and the Child and Adult Care Food Program for older adults who are disabled or living in adult care centers (Buys, 2015; Hartline-Grafton, 2019). SNAP, which is an anti-poverty initiative targeting hunger and malnutrition and the largest food support system in the US, has been shown to reduce healthcare utilization such as nursing home stays, hospitalizations and emergency department visits, as well as income-related medication non-adherence among low-income older adults (Pooler, 2019). A survey-based study using nationally representative data reported that participation in SNAP reduced the risk of food insecurity for

low-income older adult households by 18% (Nguyen, 2015). Furthermore, food-insecure older adults participating in SNAP reported an increased utilization of preventive healthcare, as well as a reduced likelihood to have depressive symptoms compared to food-insecure older adults not participating in the program (Greenhalgh-Stanley, 2013; Kim, 2007). A comprehensive evaluation of the Home-Delivered Nutrition Program revealed that participants reported a variety of positive effects on their nutrition intake, health and wellbeing such as consuming essential nutrients, improving diet quality and maintaining a healthy weight. The program overall was found to reduce food insecurity levels, hunger and adverse health conditions while advancing social wellbeing and connectedness (Hartline-Grafton, 2019; Mabli, 2017; Mabli, 2018).

While there is evidence that these programs work to improve food security and related health outcomes for older adults, many eligible older adults are not likely to participate due to mobility issues, lack of technology use, stigma, or false beliefs regarding eligibility and benefits gained from the program (Hartline-Grafton, 2019). For instance, SNAP provides food to approximately five million households with older adults each month. However, reports show that only 48% of older adults who are eligible for the program participate in SNAP (Hartline-Grafton, 2019). The disruption in food systems related to the COVID-19 pandemic has caused a great increase in demand for food supply and participation in these programs due to reduced availability, accessibility and affordability of food, especially for underserved and at-risk populations (Huizar, 2021). In fact, since the beginning of the pandemic, 98% of food banks reported a surge in demand for food assistance, while also reporting a reduced inventory and higher expenses (“Plummeting”, 2020). Due to the many pandemic-related challenges such as social distancing measures, rises in food prices, unemployment and the spread of the virus and

risk of infection, food rescue and assistance programs are needed now more than ever to reduce the additional burden of COVID-19 on vulnerable, food-insecure populations (Morales, 2020).



White Pony Express food delivery

Hypotheses/Objectives

The primary aims of the research study are to assess the impact of food insecurity on physical health, mental health and social wellbeing among low-income participants during the COVID-19 pandemic. Four main research questions/objectives evaluate the relationship between these factors. As COVID-19 is a unique period in time, additional associations are explored, controlling for participant factors such as age, income and sex.

The first main objective of the study is to evaluate how the COVID-19 pandemic has been impacting seniors in terms of their mental health, physical health and social wellbeing. This research question will examine participants' experienced impacts of COVID-19 in association with their mental health and feelings of connectedness, support and wellbeing, using the COVID-19-related change scores calculated.

The second objective of the study is to evaluate the differences, if any, within the study sample in terms of the impact of COVID-19. This research question focuses on the pre- and during-COVID-19 scores for mental health, comparing participants who have been receiving food deliveries during the pandemic and participants who have not been receiving the same food support. This question will help us understand if and how the food delivery program is impacting the participants. The hypothesis is that this program might be playing a protective role for participants who have been receiving it, in terms of alleviating the impact of COVID-19 and food insecurity.

The third objective of the study is to assess the health and nutrition scores related to diet, and food insecurity metrics in the overall study sample. We will analyze the scores related to diet and nutrition and identify key health markers. Understanding the potential differences in the

presence and/or frequency of health symptoms related to diet and positive food insecurity markers can give insight into the severity of food insecurity experienced by the study sample, and whether the food delivery program is helping lessen the impact of COVID-19 on food insecurity and overall health for the participants who have been receiving food deliveries.

The fourth objective of the study is to analyze the health and nutrition scores from only the study group who have been receiving food deliveries during the pandemic. This analysis could help us understand if the food delivery program is working to alleviate diet-related physical health symptoms and food insecurity markers, and how the study group is performing overall. These scores can also help identify health measures with very low or high scores that would be of interest to focus on and further analyze.

Secondary analyses explored whether there were subgroup differences based on participant characteristics, such as individuals living in their household, age and sex. With the shelter-in-place restrictions during COVID-19 and social isolation, participants living alone vs. with roommates/spouses might reveal differences in their mental health, physical health and emotional wellbeing. Secondary analyses also looked into any differences that might be impacted by non-modifiable factors such as sex and age.

Methods

I. Study Sample and Location

Participants were eligible for the study if they were a resident of Heritage or Plaza Tower, which are adjacent living facilities for low-income seniors located in Concord, CA. Concord is the largest city in Contra Costa County, located in the East Bay region, with a population of 128,399 -of which 19,402 are seniors- according to 2020 data (“Concord”, 2020). The median age in Concord is 38.9 years, and the racial composition mostly consists of 62.64% White individuals. The overall poverty rate is estimated to be 9.77%, slightly higher for females (10.96%) compared to males (8.56%). The racial/ethnic group most likely to be in poverty in Concord are African Americans, who are 18.92% below the poverty level, followed by multiple races, Native Americans and Hispanic/Latinos. In terms of income, the average household income is reported to be \$107,211, with median rental costs of \$1,716/month.

Heritage apartments are considered “low-income HUD housing” with residents paying rent at about 5% or lower of going rate. In order to qualify for HUD housing, residents need to have an income between 50% and 80% of the median income in the area (“HUD’s”). On the other hand, Plaza Tower is considered “affordable senior housing” with residents paying rent at about 50% of going rate. Affordable housing is when the total cost of rent and utilities is up to 30% maximum of the monthly household income, and residents usually have an income of 60% or less than the median income in the area. The residents living at Heritage have been receiving grocery-style food deliveries from White Pony Express, a food rescue organization in the Bay Area, during the COVID-19 pandemic. The residents of Plaza Tower have not been receiving

any food deliveries since the pandemic, due to the limited food supply being mainly distributed to the lower income Heritage residents.

The two facilities house approximately 300 individuals in total, who all received a study survey. The study had a sample size of 93 individuals completing the survey, and 5 completing the optional follow-up interview. 51 participants are residents of Heritage, and 42 participants are residents of Plaza Tower.

II. Study Design

The Intervention & Community Partner

White Pony Express (WPE) was founded by Dr. Carol Weyland Conner in September 2013, with the mission of “helping to eliminate hunger and poverty by delivering the abundance all around us to those in need – with love.” WPE started out with a very limited budget and zero assets, relying on volunteers and donations to create their model of delivering surplus food to organizations that serve those in need. In 2014, WPE incorporated as an independent nonprofit public benefit 501(c)(3) corporation, and added a General Store program to deliver clothing and other items to those in need. In just 8 years, its “circle of giving” model has rescued and delivered over 17 million pounds of nutritious, fresh food that would otherwise have gone to waste, as well as over 700,000 items including clothing, books and shoes. Among WPE’s main goals is to develop more elaborate quantitative and qualitative metrics to assess their impact on various populations and the overall role that food rescue/assistance programs can play in lowering the burden of food insecurity and consequently improving mental and physical health.

The Process Behind Designing the Study

This research is a mixed-methods study consisting of a quantitative survey section and an optional qualitative interview section. Since this project is in partnership with numerous stakeholders and follows a community-based participatory research model, we included the stakeholders and their feedback in every step of the study design, survey creation, data collection and dissemination (Holkup, 2004). In designing the study initially, we had numerous meetings with directors and staff at WPE, Heritage and Plaza Tower to identify key goals from all stakeholders and design specific ways to address them in the study. For WPE, the main goal was to better understand the impact of their food delivery program on participants during COVID-19, in a quantitative method. The meetings with WPE helped in understanding their perspective and research questions, which was incorporated into the survey. Our meetings with the management and staff at Heritage and Plaza Tower were crucial in getting to know the community, their background, and overall feasibility of a survey-based study in this population.

When creating the questions and statements in the survey, an effort was made to not have leading items that would prompt the participants to respond in a certain way. Also, no medical jargon or complex phrasing was included that might confuse the participants and mislead their answers. Several open-ended questions were included in the survey to make sure participants had a space designated for their personal experiences and opinions

Recruitment & Informed Consent

The survey was completely voluntary and anonymous, and the participants who completed the survey were given a box of chocolates to compensate for their time. The residents of the two living facilities received identical surveys, however Heritage received an additional

section on their survey, evaluating the food deliveries they have been receiving during the COVID-19 pandemic.

The surveys were delivered alongside a 1-page Research Consent Form including a description of the study, time involvement, risks and benefits, payments, participant rights, and contact information. The participants were informed that their survey answers would be anonymous, and that this study would not impact their food deliveries from WPE. Since the surveys were delivered to participants to be completed in their own time, the participants' completion of the survey indicated their informed consent. The Research Consent Form was translated into Spanish by Stanford Hospital Translation Services, and was offered in both English and Spanish.

The surveys were distributed to the Heritage and Plaza Tower residents by a WPE volunteer, and collected over a 3-week period. Surveys were disseminated to 300 residents, with 93 completed surveys being returned. The interviews were conducted with participants until data saturation was reached and conducting further interviews was not yielding new information that had not been gained from previous interviews.

Table 1: The Survey Sections & Key Focuses

Section	Focus	Questions	Response options	Sample item
1	Impact of COVID-19	Rating mental and physical health status for pre- and during-COVID-19	Likert scale from 1-5 1 = “worst outcome” 5 = “best outcome”	“Rate your health status in terms of diet and nutrition for your life before and during COVID-19.”
2	Health, nutrition, and food insecurity status	Ranking presence/frequency of diet-related physical/mental health markers	Likert scale from 1-5 1= “never” 5= “always”	“How often do you feel anxious about running out of food?”
3	Connectedness, support, and wellbeing	Ranking statements related to feeling connected, supported and emotionally well	Likert scale from 1-5 1= “strongly disagree” 5= “strongly agree”	“I know there are people who I can turn to for support.”
4	Demographics	Age, sex, race/ethnicity, frequency of contact with family, individuals in household, relationship status	Categories for all variables were present	“How frequently are you in contact with family/friends?”

The quantitative survey consists of 4 sections with multiple-choice and open-ended questions. Section 1 aims to assess the overall impact of COVID-19, where participants rate their diet, physical health, mental health, sleep quality and social/emotional support network on a Likert scale ranging from 1 to 5, 1 representing “the worst possible outcome” and 5 representing “the best possible outcome”, first considering their life before the pandemic, then considering their life now, since the pandemic began. Section 2 aims to assess the health, nutrition and food insecurity status of the participants, consisting of questions related to anxiety about food supply, hunger, unintentional weight loss/gain and other diet-related health marks such as fatigue, light-headedness, and hair loss. Participants rate their statuses on a Likert scale ranging from 1 to 5, 1

representing “never” and 5 representing “always”, considering the past 12 months since the pandemic began. Section 3 aims to assess the connectedness, support and wellbeing of participants both prior to the pandemic and since the pandemic began. This section includes statements related to feeling connected, supported, isolated and understood. Participants rate their statuses on a Likert scale from 1 to 5, 1 representing “strongly disagree” and 5 representing “strongly agree”, first considering their life before the pandemic, then considering their life now, since the pandemic began. This section includes 3 additional questions, aiming to understand the personal effect of COVID-19 on the participant, and whether they received their vaccine and visited a healthcare provider in the last 12 months. Section 4 consists of basic demographic questions, as well as questions related to frequency of contact with friends and/or family, number of individuals living in the same household, and relationship/marital status.

The extra section included in the survey for the residents of Heritage aims to assess the WPE food deliveries they have been receiving in terms of variety, quality and quantity, and includes 3 open-ended questions about their personal experience with the program. The survey was translated into Spanish by Stanford Hospital Translation Services, and was offered in both English and Spanish.

The last page of the survey included information on the follow-up interview, and the research team’s contact information to participate in the interview. The contact information included was a de-identified Google Voice number, and participant’s phone numbers were not associated with any names.

The survey was pilot tested on 7 individuals working with or connected to WPE before being finalized and disseminated. These individuals were in the same age range as the survey

participants, and were familiar with the food delivery program. However, they were not receiving any food deliveries from WPE, so there was no conflict of interest.

During the time of conducting survey distribution, the Bay Area was mostly under Tier 3 -moderate- and Tier 4 -minimal- restrictions, indicating fewer case rates than the past months. Individuals living in the area were strongly discouraged from attending indoor gatherings, recommending a maximum of 3 individuals per household. The older adult population became eligible to get vaccinated for COVID-19 about 1-2 months before survey distribution, and all individuals aged 16 and over in California became eligible to get vaccinated soon after survey distribution. During the period from the start of the study until the end of data collection and analysis, the restrictions in the study area of Concord, CA continued to improve as the city moved through severity tiers, from purple tier to red tier in March 2021, then to orange tier in April 2021.

The Interviews

The second component of the study was an optional, follow-up qualitative interview offered to the English-speaking residents of Heritage, although residents could also opt to do just the interview, without requiring completion of the survey. The main goal of the interviews was to learn more about the participants' experiences on the topics included in the survey such as anxiety around food supply, physical health and mental health. The interviews were semi-structured, lasting 10-30 minutes through a phone conversation or a video-based call. An interview guide was created to include specific questions on the survey section topics, although participants were encouraged to speak on any related topic of interest. The interview guide consisted of 3 main sections- the impact of COVID-19, mental health and physical health. The

physical health section included questions related to the WPE food deliveries the participants were receiving. The questions were phrased to not be leading, and engage the participant in a conversation.

All interviews were completely confidential and informed consent was obtained at the beginning of each interview. Since the interviews were conducted over the phone or via video-based call due to COVID-19 restrictions, the IRB-approved Research Consent Form was read out loud to participants, which included a description of the study, time involvement, risks and benefits, payments, participant rights, and contact information. In addition, a separate HIPAA Authorization section was included for authorization to use participants' health information for research purposes, as the interviews might contain identifiers and sensitive health information. The interviews started out with the researchers reading out loud the Research Consent Form and the HIPAA Authorization section to the participant, and obtaining the participant's verbal consent to participate in the interview. Interviews were audio-recorded with the consent of the participant, and all data was de-identified and stripped of any identifiers for data analysis. The audio recordings were deleted once data analysis was complete.

This research study, including all survey and interview content and study procedures, was reviewed and approved by the Institutional Review Board on April 15th, 2021. (Protocol Number: 60376)

III. Data management and analysis

All completed surveys were assigned an arbitrary ID number, and a codebook was created to analyze the survey data through SPSS Statistical Software. All interviews were de-identified and

assigned an arbitrary ID number. Audio-recordings of the interviews were used to code themes and extract quotes, and all recordings were discarded following data analysis.

In order to analyze the change in self-reported scores for health variables and the overall impact of COVID-19, a new change score was calculated for health measures, by subtracting the pre-COVID-19 scores from the during-COVID-19 scores for each measure. A composite score was also calculated to reflect the total change score for each participant due to COVID-19, by summing up each of the change scores calculated for all health measures. A single item from the survey, “I feel lonely and isolated from others”, was reverse coded as it was in the direction of indicating worse functioning during COVID-19, while all other statements under the same section were phrased to be in the direction of indicating better functioning during COVID-19.

For the analysis of our data via SPSS, we have utilized several statistical tests including descriptives, means, frequencies, paired-samples t-tests, independent-samples t-tests, linear regressions and reliability analyses (Cronbach's alpha test). Secondary analyses were conducted using Cronbach's alpha test in order to assess the internal validity of the scales used in the survey.

The analyses also examined whether the individual items measured a common construct reflective of health status pre- and during- the COVID-19 pandemic. To do so, Cronbach alpha coefficients were calculated for the items in different survey sections and separately in reference to pre-COVID-19, during-COVID-19, and change from pre- to during COVID-19. For all scales, the Cronbach alpha coefficients exceeded 0.80 indicating strong internal consistency or high scale reliabilities.

Results

I. Quantitative Results from the Surveys

In total, 93 participants returned their surveys for analysis, where 89 of the surveys were in English. The remaining 4 Spanish surveys were translated to English for data analysis.

Table 2: Demographic Data

Variables	Categories	Heritage (N)	Plaza Tower (N)	Total (N)
Study sample		51	42	93
Age	<60	1	2	3
	60-70	11	7	18
	70-80	27	18	45
	80-90	10	13	23
	>90	1	2	3
Sex	Female	38	29	67
	Male	10	12	22
Race/Ethnicity	African American	1	0	1
	Asian/Pacific Islander	16	3	19
	American Indian /Native American	0	1	1
	Hispanic/Latino	7	5	12
	White	23	31	54
	Other	2	2	4
Individuals in Household	0	33	30	63
	1	12	7	19
	2	4	5	9
	3	1	0	1
Relationship Status	Single/Never Married	8	8	16
	Married	8	4	12
	Divorced/Separated	24	12	36
	In a relationship/ not living with partner	0	2	2
	Widowed	10	15	25
Social Contact	Daily	17	18	35
	Daily/Weekly	4	1	5
	Weekly	19	19	38
	Monthly	7	2	9
	Annually	2	2	4
	Never	1	0	1

Demographic Data

Sociodemographic data revealed the income, age, sex, race/ethnicity, individuals in household, relationship status and social contact frequencies for the study sample, as well as for the comparison of the two study groups. Most participants were in the 70-80 age group, female, White, living alone, widowed and in contact with friends and family weekly.

Approximately 55% of the study sample were Heritage residents (N=51) belonging in the low-income HUD housing group, while almost 45% were Plaza Tower residents belonging in the affordable housing group. Between the 2 sites, Heritage participants were most likely to be female, Asian/Pacific Islander, living with 1 roommate, divorced/separated, and in contact with friends and family monthly.

Among the study sample, 90.3% reported that they had received the COVID-19 vaccine, and 89.2% stated that they had visited a healthcare provider in the last 12 months.

Impact of COVID-19: Research Questions 1 & 2

I. The Full Study Sample

Paired sample t-tests indicated significant differences in participant' reports on pre- and during- COVID-19 measures of "health status in terms of diet and nutrition" (p=0.009), "physical health" (p=0.002), "sleep" (p=0.030), "mental health" (p= 0.012) and "social network" (p=0.008). Examining mean change scores indicated that for all measures, participants reported doing worse during the COVID-19 pandemic.

II. Comparing Heritage vs. Plaza Tower Residents

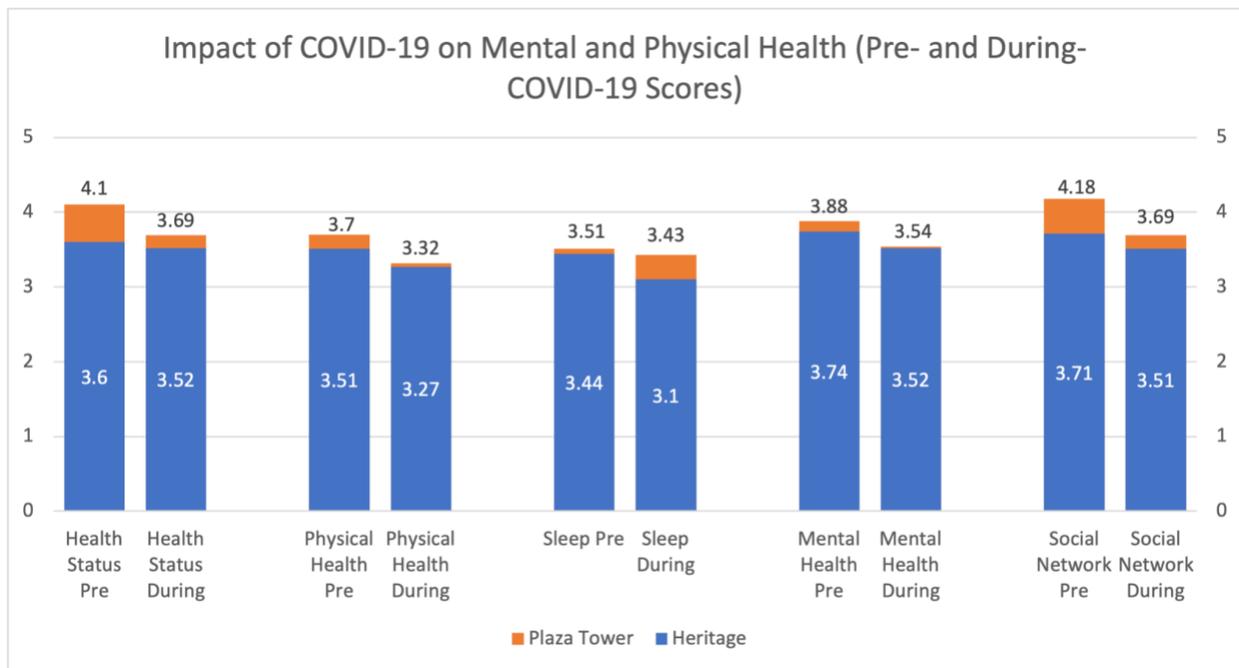
We examined reports on these measures by group, comparing Heritage and Plaza Tower residents. Comparing pre-COVID-19 scores only, Heritage residents had lower scores than the higher income Plaza Tower residents for all measures including “health status in terms of diet and nutrition”, “physical health”, “sleep”, “mental health” and “social network”. The differences between the two study groups were statistically significant for pre-COVID-19 scores on “health status in terms of diet and nutrition” ($p= 0.006$) and “social network” ($p= 0.032$). Comparing the during-COVID-19 scores only, Heritage residents had slightly lower scores than the higher income Plaza Tower residents for “health status in terms of diet and nutrition”, “physical health”, “sleep”, and “social network”, but not for “mental health”, and the differences did not reach statistical significance. That is, the difference in scores reflecting pre-COVID-19 between Heritage and Plaza Tower residents narrowed when compared with the during COVID-19 scores. This is because, on average, the Plaza Tower residents reported a greater decline in “health status in terms of diet and nutrition”, “physical health”, “mental health” and “social network” during the COVID-19 pandemic compared to the Heritage residents, although the difference in change scores between the two groups did not reach statistical significance.

III. Associations with Other Variables

The number of individuals living in the household impacted “mental health” ($B = 0.269$, $p = 0.110$) and “social network” ($B= .446$, $p = 0.015$) during COVID-19, although it did not reach statistical significance. When looking at the impact of age on COVID-19-related changes, it was a nearly statistically significant contributor in terms of “physical health” ($B= .131$, $p= .061$). The strongest association with sex was “overall health status in terms of diet and nutrition”

($B = -.423$, $p = .109$), although it was not statistically significant. There was a greater decline observed for health status in terms of diet and nutrition during COVID-19 in men, who on average experienced a decline of 0.611 (-0.6111) in their rating while women experienced an average decline of 0.23 (-0.2295).

Figure 1: Impact of COVID-19 on Heritage vs. Plaza Tower Residents



***This section of the survey asked participants to rate several health measures (health status, physical health, sleep, mental health, social network) for their life pre-COVID-19 and during-COVID-19.*

Overall Health and Nutrition: Research Question 3 & 4

I. Comparing Heritage vs. Plaza Tower Residents

Looking at the differences in health metrics between Heritage and Plaza Tower study groups overall, Heritage reported “unintentional weight loss” ($p= 0.009$) and “trouble staying full between meals” ($p= 0.017$) more often than Plaza Tower residents. Although not statistically significant, the Heritage study group reported “feeling anxious about food supply”, “feeling hungry without enough money to buy more food” and “feeling anxious about running out of food” more often than the Plaza group.

II. Heritage Residents

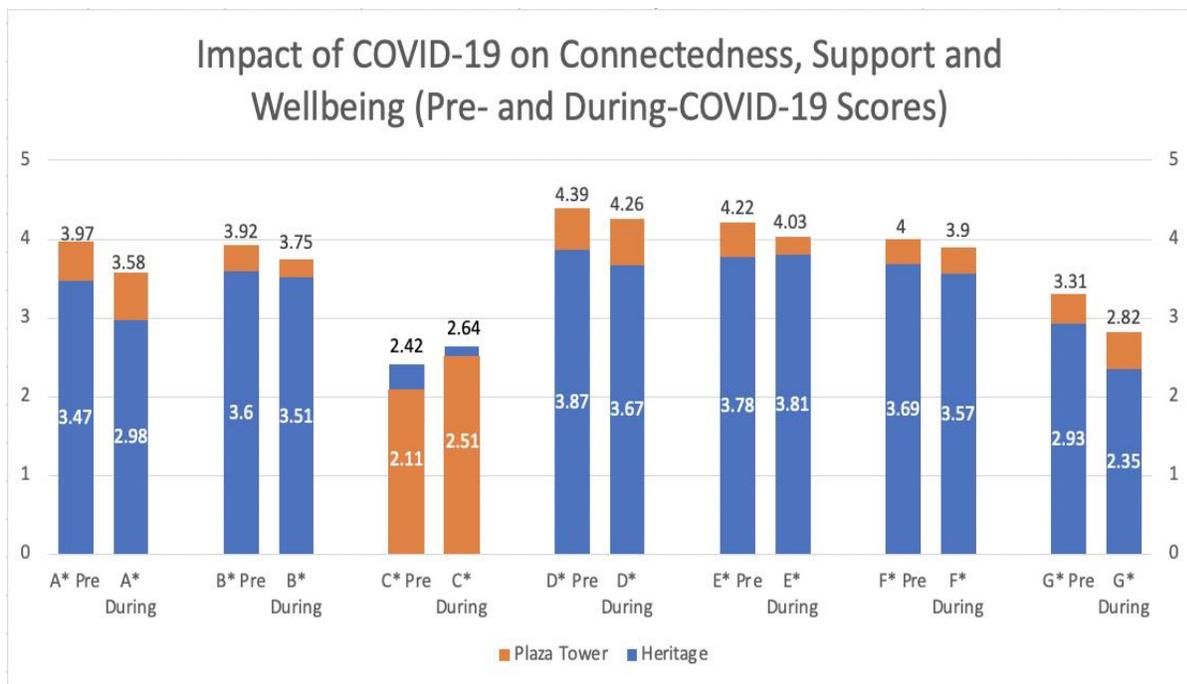
Among Heritage residents, highest mean scores -indicating that the participant is experiencing an event more frequently- were seen for “unintentional weight gain related to diet” (2.52), “issues with hair loss or brittle nails” (2.04), “feeling anxious about food supply”(2.04) and “feeling hungry after eating a meal” (2.00).

Connectedness, Support, Wellbeing: Research Question 2

There was a statistically significant change between the pre-COVID-19 and during-COVID-19 scores for the total sample for the following variables: “feeling connected to my community” ($p=0.003$), “feeling lonely and isolated from others” ($p=0.043$), “having people to call or write to” ($p=0.023$), and “eating in the company of others” ($p<0.001$). There was no statistically significant difference between the 2 study groups in terms of connectedness, support and wellbeing due to COVID-19.

How many individuals the resident was living with (“individuals in the household”) had a statistically significant impact on “feeling lonely and isolated from others” ($B = .450, p = .051$) and although not statistically significant, “eating in the company of others”. ($B = .360, p = .108$). No significant age or sex differences were observed in reports of connectedness, support and wellbeing.

Figure 2: Connectedness, Support and Wellbeing Scores for Heritage vs. Plaza Tower Residents



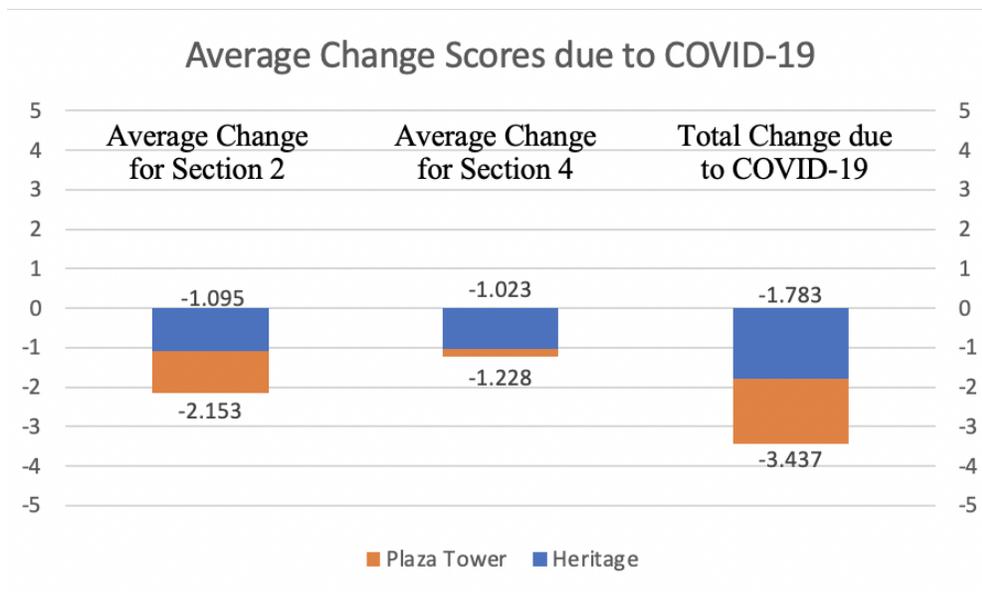
**A-G refers to statements on the survey related to connectedness, support and emotional wellbeing that participants rated for pre-COVID-19 and during-COVID-19 on a Likert scale from 1-5, 1 indicating a poorer, negative score and 5 indicating a higher, positive score.*

A: “I feel connected to my community” ; B: “I feel support from those around me” ; C: “I feel lonely and isolated from others” ; D: “I have people who I can call or write to” ; E: “I know there are people who I can turn to for support” ; F: “I feel that there are people close to me who understand me” ; G: “I often eat in the company of others.”

Secondary Analyses

Comparing the total effect and change due to COVID-19 between study groups revealed that Plaza Tower residents on average experienced a greater decline in all of the health and wellbeing scores measured (68.74% decline on average) compared to Heritage residents (35.66% decline on average), although the difference did not reach statistical significance.

Figure 3: Total COVID-19 Effect on Heritage vs. Plaza Tower Residents



***These average change scores reflect the change from pre-COVID-19 to during-COVID-19 scores reported by Heritage and Plaza Tower residents, for Section 2 “Impact of COVID-19 on Mental Health and Physical Health”, Section 4 “Connectedness, Support and Wellbeing” and the total overall change for both sections.*

II. Qualitative Results

Figure 4: Main themes derived from the qualitative survey questions



The survey included an open-ended question asking about the personal impact of COVID-19 on access to food, connection with others, health and wellbeing -if any, where a lot of significant themes were uncovered. The main themes derived overall were depression, isolation and loneliness, anxiety about food supply, lack of access to food, anxiety about health status during COVID-19, lack of access to family and friends, loss of connection and emotional support, lack of social activities and social interaction within the community, lack of access to healthcare, and physical inactivity (Fig. 3).

One participant stated: *“COVID-19 has seriously complicated my access to food, access to doctors, access to any clubs, groups, or friends. It made me an introvert and afraid to do anything publicly.”* Another participant stated: *“My regular weekly activities have*

stopped and my general health, both physical and mental, has suffered from the lack of daily activity.”

For the residents of Heritage, an additional open-ended question was included to assess the impact of WPE food deliveries, asking the residents to expand on their personal experience with the program. The major themes identified in this question were relief related to food supply, additional support during COVID-19, and reduced stress.

A resident stated: *“How thankful we are to have this program. I know I will never be without food or go hungry.”* Another resident stated: *“This [the WPE food delivery program] is helpful due to the fact that it's hard for me to shop for food. It keeps me from stress to have enough food.”*

Additionally, we conducted 5 interviews where we gained further insight into these themes and their significance during the challenging time of COVID-19. We also uncovered some additional themes that might have a protective value for the participants. The major themes identified from the interviews related to mental health were isolation, anxiety, fear of the unknown, stress and lack of social elements. Many participants reported feeling isolated and lonely during the shelter in place restrictions, which contributed to physical restrictions in obtaining food for the household.

“I used to go out and suddenly I stopped. (...) I didn't have any food. I didn't have any contact with friends. I wondered if I would get sick.”

Most of the participants reported feeling anxious, both about the virus and ongoing pandemic, and also about their food supply. One participant reported that they were feeling a higher, more severe anxiety than usual due to all the recent changes.

“Anxiety was the first thing I felt [when the pandemic hit]. I had to adjust my lifestyle, I couldn't go out anymore. Everything was closed, there was a quietness around everything.”

Heritage residents discussed that they felt anxious about their current food supply in their household, due to not being able to leave their residences with the shelter in place restrictions. Some had families that were able to bring them food, but some had to find alternative sources of food through various programs and make do with what they had. They had to adjust their daily schedules to live with something new, while experiencing a fear of the unknown.

“My whole life has changed, I am living differently. I now live alone [after my husband passed away] and have to find a new way to get groceries. I used to hop in a car and get them myself, but now someone else has to do it for me. It is very complicated.”

Participants expressed that they experienced heightened stress due to various COVID-19 related challenges, such as health problems, loss of income and disruption to social and emotional wellbeing.

“I am a caregiver and I lost my income during the pandemic due to shelter in place restrictions. I was very nervous about rent, finances, expenses, and my food supply. They [the building management] provided us with 2 meals per week, which was good because I needed it.”

Many residents stated they felt depressed more often during the last 12 months, due to the sudden changes in their lives and daily routines. The reasons included reduced social connections within the community, and with other family members and friends, as most residents felt they did not have anyone to talk to most of the time. Residents also stated that the lack of social activities in the community such as clubs, card games, events, and meals further caused them to feel depressed.

“Normally, I’m an early riser and I have activities to do. I go out, see my friends and socialize. Now, I wake up at 6.30 in the morning and have nothing to do. It has been challenging.”

In terms of physical health and diet changes, most participants reported that they were in fact eating healthier meals during the pandemic, because they were cooking more at their homes utilizing fresh produce. However, many residents complained about their physical inactivity during shelter in place restrictions, and the health problems they have caused over the last year.

“I wasn’t able to go to the gym in the building during the pandemic. I had very limited physical activity levels and gained a lot of weight, which led to sleep issues.”

One interesting theme that was uncovered from the interviews was the role of religion and spirituality. Many of the participants reported religion/spirituality as a protective factor that was significant to them in terms of their health and wellbeing, stating that it was as essential as food during this time. One participant who attended services over Zoom video-calls during the shelter in place restrictions reported spirituality as a major theme.

Discussion

Significance of Results

The sociodemographic data revealed that the majority of the study sample consisted of socially isolated older women who were divorced or separated, and did not have a daily source of social contact, which research shows are the most vulnerable among the older adult population. On average, most participants experienced a significant negative impact due to COVID-19 for all health measures collected, including diet and nutrition, physical health, mental health, sleep and social network. The residents of Heritage, who are more limited in terms of income than Plaza Tower residents, were at a lower point for all health measures before COVID-19 compared to the other study group, especially for health status in terms of diet and nutrition and social network. However, there was no significant difference between the two study groups in terms of the during-COVID-19 scores. This indicates that the health and wellbeing measures of the two study groups became more comparable during COVID-19, possibly due to the food deliveries Heritage residents have been receiving during the pandemic. With these food deliveries, Heritage residents were further protected despite their lower income status, and although they were doing worse off at the beginning, the gap in health and wellbeing significantly reduced between the two study groups. Looking at the change in scores of the higher-income Plaza Tower residents during COVID-19, there was a greater reduction compared to Heritage residents, possibly due to the lack of food deliveries acting as a protective factor. Overall, Heritage residents are in the lower income status compared to the other study group, which already puts them at a higher risk for vulnerability to poor health and COVID-19 effects. The fact that Heritage residents are receiving food deliveries, when Plaza Tower residents are

not, indicates that they are in need of more resources and assistance during this challenging time. Individuals living in the household was a notable factor that was associated with mental health and social network, supporting the evidence-based connection of social isolation and poor mental health outcomes from previous research.

The Heritage study group reported more food insecurity indicators than the Plaza Tower study group, including unintentional weight fluctuations, hair loss/brittle nail issues, trouble staying full between meals, feeling anxious about food supply and feeling hungry without money to purchase more food. The Heritage group is experiencing higher levels of food insecurity, and more symptoms associated with it. This further reveals that the Heritage group is doing poorer in terms of physical health and wellbeing, despite the food deliveries they are receiving, which is possibly linked to their lower income and higher vulnerability status.

In terms of mental health and social wellbeing, both groups were affected by COVID-19 regardless of their income status. However, looking at the overall impact of COVID-19 on the two study groups, Plaza Tower residents were slightly more impacted compared to Heritage residents, possibly due to the lack of food assistance they were receiving during the pandemic. Overall, while Heritage residents who have been receiving food are not performing significantly better than the Plaza Tower residents, there is a protective factor present that is reducing the health gap between the two groups.

The Cronbach's alpha tests we ran revealed that the survey scales had high internal validity and reliability. Although most differences between the two study groups were not statistically significant, the scales were performing as expected and a greater sample size could have yielded more statistically significant results.

Income seems to be a significant factor overall, where the lower income Heritage group

reported poorer physical health and mental health status both before and during COVID-19. However, with the food deliveries they have been receiving all year, this group is performing much better during COVID-19 than they would have without the deliveries, and did not show a large difference in health status compared to the other group.

Limitations

This study has several limitations. First, the sample size was smaller than expected. While the surveys were distributed to 300 residents, the response rate was lower than expected, about 31%. A larger sample size might provide slightly different results and higher generalizability,, giving more insight into the true change in health and wellbeing status of this population during COVID-19.

Second, all of the health and wellbeing scores used for data analysis were self-reported scores. Self-report may fail to fully capture one's physical or mental health functioning due to selective recall, social desirability (to answer in a more socially acceptable way) or impact of the participant's mood while filling out the survey, which might introduce bias. There were some sensitive subjects included in the survey such as mental health and emotional wellbeing, which might have affected unbiased, objective self-scoring as well. Also, while participants might have scored their health measurements as the same for pre- and during-COVID, there might be objective improvements or reductions in health and quality of life that the participant is unaware of. These instances can also play a role in impacting the study results. Future research could include medical record data provided by physicians, as well as data from interviews with family

members or caregivers to gain a more thorough representation of the participant and their health status.

Third, our control group of Plaza Tower had limitations that may have impacted our comparison of the two study groups. While the research questions aimed to evaluate the differences between a study group receiving food deliveries during the pandemic and a study group who was not, the two study groups had slightly different sociodemographic characteristics that might have impaired a true comparison with all known confounding factors limited. Comparing study groups among the same housing, and therefore same income range, that are receiving food and are not receiving food might give us further insight into the impact of the food delivery program alone, separated from the impact of COVID-19 on all residents.

Fourth, both senior housing residences are for low-income seniors, and Heritage is considered to be HUD senior housing. This indicates that most residents have less than 50% of the median income in the area, and qualify for this housing. Thus, most participants are low-income, and potentially have reduced physical health and mental health status to begin with, due to the relationship of these health variables with income. Although our findings on the impact of the WPE food rescue program in alleviating food insecurity and improving health may not have been significant, this does not mean that the program is having no effect. It might still be positively contributing to the overall health and wellbeing of the participants to bridge the health and wellbeing gap between the two study groups in ways that we could not measure, and would need further research.

Overall, COVID-19 has had a great impact on all dimensions of society and it cannot be overlooked when interpreting the results. The pandemic and its consequences are highly multifaceted, affecting many areas of health and wellbeing. Thus, only targeting the alleviation

of food insecurity, while important, may not be sufficient to improve the health and wellbeing of the low-income senior population. Further research can give insight into other variables that may be playing a role and could be targeted for the betterment of this population and their quality of life overall.

Future directions and next steps

This research study is important in that it explores the potential role that food rescue/assistance programs can have in alleviating symptoms of food insecurity, especially during COVID-19, while protecting and enhancing physical health and mental health. Food and nutrition are vital components of human wellbeing, and thus it is essential to evaluate and promote such programs that provide necessary food and resources for food insecure, low-income individuals. It is also critical in that there is not enough accessible and relevant data specific to the older adult population, which is a highly vulnerable population -especially during a life-threatening pandemic.

For future studies, recruiting a larger sample size can give more insight into the true impact of COVID-19 and participation in food rescue/assistance programs during a challenging time. A larger sample size can reveal whether there are within-group differences due to certain factors that this study was not able to identify or measure. Assessing these differences can help further improve the health status of low-income older adults by targeting specific areas of vulnerability or protection. Furthermore, the interviews yielded a key theme regarding the role of religious/spiritual resources in enhancing health and wellbeing. Future research can incorporate this theme and assess its significance for various populations, in order to develop better tailored services and fulfill essential needs that contribute to quality of life. In terms of assessing the

long-term impact of COVID-19 on physical and mental health in this population, future research can dive deeper into post-COVID-19 assessments, similar to this study which asked participants to rate several health measures for their lives before the pandemic, and during the pandemic. Post-COVID-19 scores could provide more insight into how this population is coping with and adjusting to new challenges, such as possible continued social isolation and hardships in accessing fresh food. Moreover, future studies targeting this population can obtain and incorporate participants' detailed health histories and/or physician reports to complement self-reported health measures, and additionally interview participants' families or caregivers to obtain more information on their health from an outside perspective. As self-reports can be biased, these health records can help identify the true impact of food rescue/assistance programs, which play a significant role for the low-income, food insecure population.

This research study revealed that both food insecurity and COVID-19 are multidimensional phenomena associated with various environmental, societal, psychological and behavioral factors that cannot be alleviated with a single mean or resource. Food insecurity has been a rampant problem for decades, which has been exacerbated by the COVID-19 pandemic and will possibly further progress in terms of long-term consequences. Thus, immediate action must be taken to stop the progression of health disparities and public health crises which lead to further short-term and long-term problems. Understanding this public health emergency and the burden on this population can better guide policy makers to develop more relevant and suited health systems and resources to help low-income older adults alleviate their food insecurity and improve their physical health, mental health and overall wellbeing.

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Supplementary Documents

I. The Survey

SECTION 1: WHITE PONY EXPRESS

For the following questions, please write whatever comes to mind.

How has your experience with White Pony Express been? What would you tell your family and friends?

SECTION 2: IMPACT OF COVID-19

For this next part, please imagine a scale from 1 to 5, 1 being the worst possible outcome for you, 5 being the best possible outcome for you. Please give a rating from 1 to 5 to the questions, **first thinking about your life before the COVID-19 pandemic, and then thinking about your life since the COVID-19 pandemic began.**

1



Worst

2



3



4



5



Best

Using the scale above, rate each statement from 1 to 5.

- A) Your health status in terms of diet and nutrition.
- B) Your physical health.
- C) Your sleep quality.
- D) Your mental health.
- E) Your social and emotional support network.

PRE-COVID

NOW

_____	_____
_____	_____
_____	_____
_____	_____
_____	_____

SECTION 3: HEALTH AND NUTRITION

For this section, please indicate how often each of the following questions is true. Imagine a scale from 1 to 5, 1 being “Never” and 5 being “Always”, as shown below:

1 **2** **3** **4** **5**
Never **Rarely** **Sometimes** **Often** **Always**

For each question, please answer **considering only the past 12 months**.
Place a check mark in the appropriate box.

	1	2	3	4	5
A) How often do you feel anxious about your food supply?					
B) How often do you feel hungry after eating a meal?					
C) How often do you feel hungry, without enough money to buy more food?					
D) How often do you feel anxious about running out of food?					
E) How often do you notice unintentional weight loss as a result of not having enough food?					
F) How often do you have trouble with unintentional weight gain related to your diet?					
G) How often do you eat less or skip meals because there isn't enough money for food?					
H) How often do you feel fatigue or have low energy due to lack of food?					
I) How often do you feel dizzy or light-headed due to lack of food?					
J) How often do you have issues with hair loss or brittle nails?					
K) How often do you notice white marks on your nails?					
L) How often do you have trouble staying full between meals?					

SECTION 4: CONNECTEDNESS, SUPPORT AND WELLBEING

For this portion, consider how true the following statements are in your life. Please think about these statements **prior to the COVID-19 pandemic**, and then think about them **since the pandemic began**.

Rate how much you agree with the statements from 1 to 5 on the scale, 1 representing “strongly disagree”, and 5 representing “strongly agree”.



1) Rate each statement considering your life before and after COVID.	<u>PRE-COVID</u>	<u>NOW</u>
A) I feel connected to my community.	_____	_____
B) I feel support from those around me.	_____	_____
C) I feel lonely and isolated from others.	_____	_____
D) I have people who I can call or write to.	_____	_____
E) I know there are people who I can turn to for support.	_____	_____
F) I feel that there are people close to me who understand me.	_____	_____
G) I often eat in the company of others.	_____	_____

2) How has the COVID-19 pandemic affected your life? (eg. access to food, connection with others, general health and wellbeing).

3) Have you received the COVID-19 vaccine? Circle one. Yes No Declined

4) In the last 12 months, have you visited a healthcare provider? Circle one. Yes No

SECTION 5: DEMOGRAPHICS

Please fill out the following demographic information by circling the answer.

1) What is your age? <60 60-70 70-80 80-90 90+

2) How do you identify? Man Woman Another Gender

3) How do you identify? You may circle more than one.

White African American/Black American Indian/Native American
Asian/Pacific Islander Hispanic/Latino Other _____

4) How frequently are you in contact with family and/or friends?

Daily Weekly Monthly Annually Never

5) How long have you been receiving food from White Pony Express?:

_____ years _____ months

6) How many individuals do you live with in your household?

0 (just you) 1 2 3+

7) What is your current relationship status? Single (never married) In a relationship/not living with partner

Married/living with partner Divorced/Separated Widowed

----- **End of Survey** -----

THANK YOU!!

Once you are finished, please place your completed survey into the Manilla envelope, seal the envelope, and drop it into the mailbox in front of your door.

Thank you for taking the time to participate in this survey. A White Pony Express volunteer will pick up your **sealed** envelope and drop off a box of See's Candies chocolates in your mailbox. Your responses will help us better understand wellbeing in senior communities and how we can better serve you during this challenging time.