

The Relationship between Food Insecurity and Fruit and Vegetable Consumption Among
Caregivers Participating in the Nutrition Incentive Program

by

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ABSTRACT

Background: Studies have addressed food insecurity (FI) and fruit and vegetable (FV) consumption; however, not many have looked at the relationship between FI and FV consumption of caregivers with children. Researchers have not extensively evaluated if locale (urban and rural) plays a role in FV consumption. This cross-sectional study investigates the relationship between FI and consumption of FVs in caregivers and whether this relationship varies by locale.

Methods: Caregivers with children completed baseline surveys as part of the Nutrition Incentive programs from the Gus Schumacher Nutrition Incentive Program (GusNIP) were included in analyses (n=3455; mean age= 33 ±0.12 years, 53.8% female).

Caregivers reported their intake using the Dietary Screener Questionnaire (DSQ). The USDA 6-item food security screening module was used to assess food insecurity. Zip codes and Rural-Urban Continuum Codes (RUCC) were used to identify locale. Mixed linear models adjusted for sociodemographics (age, sex, race, and ethnicity), and clustered at the site level were used to assess the relationship between FV consumption and FI. Locale was examined as an interaction and was found to be not statistically significant, was included as a confounder in the models. Sensitivity analyses were conducted examining all FVs, FVs without potatoes included, FVs without juice included, and FVs without potatoes or juice. Results did not vary greatly, the aggregate FV variable is reported on below.

Results: The mean FV consumption was 4.83 +/- 0.060 servings. The prevalence of FI was 78.7%. FI was reported at 92.9% of urban households and 7.1% of rural households.

The mixed linear model indicated that there was a significant relationship between FI and participant's FV consumption ($\beta=-0.51$, 95% CI: -0.81, -0.22). This study found a relationship between FV consumption and locale only.

Conclusion: Caregivers' FV consumption was significantly related to FI status; however, locale was not associated with their FV consumption. Research should further investigate the relationship between locale and FV consumption with consideration in the adolescent aged population, as these findings may be limited given the relatively small proportion of families living in rural settings.

DEDICATION

This thesis is dedicated to my mother and father. Throughout my entire life my parents have supported me in everything I have done. They have believed in me sometimes more than I believed in myself. My parents are always there for me even being thousands of miles away, and I really appreciate that. I also want to dedicate this thesis to my boyfriend, Alex, he was always there for me and would read each rough draft and provide me with valuable feedback. He would take me on adventures to help relieve some stress and I would look forward to every adventure as a much-needed break. Thank you all for helping me accomplish my thesis.

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CHAPTER 1

INTRODUCTION

Overview

Fruit and vegetables (FV) contain important nutrients that promote health and protect against chronic disease¹ such as diabetes,^{1,2} stroke,¹ overall cancer,^{1,3} and all-cause mortality.^{1,4} The 2020 Dietary Guidelines for American provides FV consumption recommendations for adults of all age groups (Table 1). According to the DGAs, adults have a low intake of FV per week. (Table 2). The 2020 Dietary Guidelines for Americans (DGAs) also provides FV consumption recommendations for children of all age groups (Table 3). However according to the DGAs, both male (M) and female (F) adolescents are consuming too few FV per week (Table 4). Low intake of FV can lead to low levels of calcium, vitamin D, potassium and dietary fibers.^{5,6}

Table 1.

Fruit and Vegetable Dietary Guidelines for Americans Recommendations for Adults^{2,7}

Age Group	19-30 years of age	31-59 years of age
Servings per 2,000 Calorie Diet per day	Fruit : 2.5 cups (M) & 1.75 cups (F) Vegetables : 3-4 cups (M) & 2.5 cup (F)	Fruit: 2.5 cups (M) & 1.75 cups (F) Vegetable: 3-4 cups (M) & 2-3 cups (F)

Table 2**Estimated Fruit and Vegetable Intake among Adults^{2,7}**

Age Group	19-30 years of age	31-59 years of age
Servings per 2,000 Calorie Diet per day	Fruit : 2 cups (M) & 1 cups (F) Vegetables : 1.5-1.75cups (M) & 1.5-1.75 cup (F)	Fruit: 1 cup (M) & 1 cup (F) Vegetable: 1.75-2 cups (M) & 1.5 cups (F)

Table 3.**Fruit and Vegetable Dietary Guideline for Americans Recommendations for children ^{2,7}**

Age Group	2-4 years of age	5-8 Years of age	9-13 years of age	14-18 years of age
Servings per 2,000 Calorie Diet per day	1-2 cups of vegetables 1.5 cups of fruit	1.5-2.5 cups of vegetables 2 cups of fruit	2 ½ cups of Vegetables 2 cups of Fruit	2 ½ Cups of Vegetables 2 Cups of fruit

Table 4.**Estimated Fruit and Vegetable Intake among children^{2,7}**

Age Group	2-4 years of age	5-8 years of age	9-13 years of age	14-18 year of age
Servings per 2,000 Calorie Diet per day	Fruit : 1.25 cups (M) & (F) Vegetables : .75 cups (M) & (F)	Fruit: >1 cup (F) & 1 cup (M) Vegetable: >1 cup (M) & (F)	Fruit: >1 cup (M) & 1 cup (F) Vegetable: 1 cup (M) & 1 cup (F)	Fruit: 1.25 Cups (M) & 1 Cup (F) Vegetable: 1 Cup (M) & 1 Cup (F)

Food insecurity is experienced when a household cannot provide enough food for every person to live an active, healthy life.⁸ Food insecurity can influence what any person eats and their FV choices.⁹ Frequently poor dietary patterns are linked to food insecurity, including diets low in FV. For example, Kendall and Olson found a significant

decrease in consumption of FV who experience food insecurity and hunger.¹⁰ A study on the home environment found that there are positive associations between FV consumption, availability, accessibility, and parental FV intake. Children who live in food-insecure households are at risk for adverse developmental outcomes, including poor social function and low developmental trajectories from kindergarten through 3rd grade.¹¹ It was concluded that these are modifiable characteristics that can serve as potential targets for interventions to promote intake in children and adolescents.¹² There is such a thing called Parental self-efficacy (PSE) and higher PSE has been associated with children having regular activity and FV consumption however, parents with low PSE have less competent parenting practices and researchers saw a decrease in FV consumption.¹³

In addition to food insecurity and having a low income, the location a person lives can also increase their risk for poor nutrition intake, such as rural or urban locale. A rural area is comprised of open country and settlements with fewer than 2,500 residents.¹⁴ Whereas urban areas encompass larger areas and are heavily settle areas.¹⁴ Rural adult residents are at a higher risk for health disparities including experiencing inequities related to low consumption of fruits and vegetables.¹⁵ Living in a rural area can also have negative effects on the family and family members. These negative effects include increased risk for obesity, hypertension, and type II diabetes. One study found that family members in rural areas are 25% more likely to be overweight or obese than those members who live in the urban counterpart.¹⁶ In rural areas, FV access is limited due to a lack of transportation infrastructure.¹⁷ There is minimal research on caregivers with

children living in urban areas that focuses on FV consumption, however, food deserts that are within urban areas tend to have lower FV consumption than urban areas without a food desert.¹⁸

Given the known benefits of consuming diets high in FV, and the association between low consumption among low-income, food insecure families,¹⁹ federal interventions have been designed to increase access to and consumption of fruits and vegetables by families in need. The United States Department of Agriculture (USDA) funds the Gus Schumacher Nutrition Incentive Program (GusNIP), previously known as the Food Insecurity Nutrition Incentives Program (FINI). This grant is used to increase the purchase of FV among low-income communities that participate in the Supplemental Nutrition Assistance Program (SNAP), by providing FV incentives at the point of purchase.²⁰

The 2018 Farm Bill approved the program for the fiscal years 2019- 2023 with a growth in program funding from \$45 million to \$56 million over 5 years.²⁰ With this support, GusNIP funds three different grant types, Nutrition Incentive Grants, Produce Prescription Grants, and Cooperative Agreement. The Nutrition Incentive Grant has three different project types including pilot projects, standard projects, and large-scale projects.²⁰ Understanding differences in baseline consumption of fruits and vegetables among caregivers with children will help investigators to better understand the impact of the GusNIP program on improving FV consumption.

The Purpose of the Study

The purpose of this study is to determine if there is a relationship between food insecurity and consumption of FV in caregivers with children and how that relationship varies between rural and urban areas. The study is focused on the low-income caregivers' FV consumption in order to see if locale plays a role in their intake. This study will set the stage for future studies to see how caregiver consumption affects children's FV consumption. Baseline surveys will be used among GusNIP grantees who participate in Nutrition Incentive programs during the 2020 & 2021 grant years.

Research Aim and Hypotheses

Research Question 1: How is food insecurity related to fruit and vegetable consumption?

Hypothesis: Caregivers who are food insecure will have a lower consumption of fruits and vegetables

Research Question 2: How does that relationship vary between families living Rural vs. Urban areas?

Hypothesis: The rural population will consume more fruits and vegetables than the urban population.

Definition of Terms

Produce Prescription Program: is a grant that funds projects for nonprofits who partner with healthcare provider to provide fresh fruits and vegetables to communities that are experiencing food insecurity.²¹

Nutrition Incentive: Programs that increase the purchase of fruits and vegetables by low-income participants by providing incentives at the point of purchase²²

Rural: open areas that have few settlements with fewer than 2,500 residents ¹⁴

Urban: larger places, densely populated, and more settlements.¹⁴ Two types urbanized areas include communities that have 50,000 or more people which are considered urban area and urban clusters which have more than 2,500 but less than 50,000 people.²³

Food Insecurity: is a lack of food intake due to lack of money and/or other resources. It can affect all people regardless of age.²⁴

Caregiver: a person who provides care to people who need help taking care of themselves.²⁵ For this study a caregiver can be a parent, grandparent, step parent, etc.

CHAPTER 2

REVIEW OF LITERATURE

Introduction:

A person's childhood years can establish a foundation for healthy eating habits throughout a person's life.²⁶ FV are the basis for healthy nutrition as they help prevent non-infectious disease. The World Health Organization recommends an intake of more than 400g of fruits and vegetables per day.²⁷ A high FV intake has beneficial effects on preventing excessive weight gain in adulthood. FV consumption can be dependent on food security status and a variety of other factors including locale.²⁸ Due to the complex nature of food insecurity and consumption of FV intake in caregivers and that relationship with urban and rural areas there is mixed literature on if a relationship exists for this population.

Dietary needs and patterns:

Nutrition is an important aspect of life. FV consumption is extremely important during the growth period to avoid potential health issues later on in life including type II diabetes,² cardiovascular disease,³ hypertension⁴ and obesity.^{3,29} FV contain vitamins, minerals and fibers as well as plant sterols, flavonoids and antioxidants.²⁷ It is beneficial for adults to consume foods with a large vast of nutrients such as FV, whole grains and lean meats.³⁰ It is important that children consume nutrient-dense foods, FV, complex carbohydrates with a total fat intake less than 30% of their total energy.³¹ The 2016 Feeding Infants and Toddlers Study (FITS) shares that ¼ of children do not eat a single

serving of vegetables on any given day and that consumption of 100% fruit juice and fruit has decreased since the FITS study in 2008.³²

Diet Quality: The quality of diet is measured as a summary index that represents the overall quality of the food consumed as well as the quality of the underlying components.^{33,34} Diet quality is measured using a tool called the Diet Quality Index-International (DQI-I). It has four main components: variety, adequacy, moderation, and overall balance.^{27,28} Children's variety of FV intake will benefit them as they grow up as many food behaviors are developed in adolescence.²⁴ A study was conducted that found that children commonly consumed whole fruit that was cut up and fruit juice whereas the most consumed vegetable was white potatoes followed by red and orange vegetables but children primarily consumed tomatoes, only 22% of these children consumed 3-5 different FV.³⁵

Unhealthy diet behaviors include eating habits that lead to an increased intake of foods high in saturated fat, sugar, and processed food products as well as a decrease in healthy food such as fruits and vegetables.²⁸ Previous studies have shown that poor diet quality is associated with mental health concerns in children and adolescents including depression, anxiety, and hyperactivity disorders that can continue into adulthood.^{36,37,38} Children with poor diet quality also encounter greater problems with their development and academic performance.^{39,40} In one study, 10–11-year-olds completed a Food Frequency Questionnaire (FFQ) and their parents completed a home survey reporting on sleep and screen time habits.³² The researchers found that these lifestyle behaviors (such

as increasing fruits and vegetable consumption) have a positive effect on academic achievement.³²

General Parent Dietary Intake: Adults have a wide variety of dietary patterns and different types of intakes. Dietary intake in one study was talking about how male gender, low education level and smoking were associated with poor dietary intake and those that have low physical activity and smoking were associated with processed foods.⁴¹ For food insecure parents it is not just about eating but it can lead to restriction, pressure to eat and food availability or accessibility.⁴² Parents who have to deal with this tend to consume diets high in saturated fat and processed foods.⁴² One researcher found that parents who participated in EMPOWER and Early Food for Future Health learned the importance of eating a healthy meal in front of their children and learned how to better educate their families through their eating habits.⁴²

General Child Dietary Intake: Based on an analysis of the 2015-2016 What We Eat in America (WWEIA), the dietary component of the National Health and Nutrition Examination Survey (NHANES), children ages 2-4 have a healthy eating index (HEI) score of a 61 out of 100, indicating their average diet does not align with the recommended DGAs.⁴³ Children ages 5-8 have a score of 55, ages 9-13 a score of 52 and ages 14-18 a score of 51.⁴³ Sugar is also a large part of children's diets on average, making up 17% of what children consume each day, a large part of that comes from sugar sweetened beverages.⁴⁴ FV consumption is highest among very young children and lowest among adolescents as evidence by the WWEIA.^{45,5}

Dietary Patterns: A dietary pattern is the combination of food and drinks that are consumed over the course of any given day, week or year taking into consideration the quantity, and variety.⁴⁶ Many studies have explored dietary patterns in children and there are “universal” patterns that have been found in various countries and many different age groups.^{47,48} An example of a universal pattern is a high intake of snacks and unhealthy energy-dense foods.^{38,39,49,50} One study showed that sleep duration, maternal education and physical activities were positively associated with dietary patterns that included foods of plant origin (fruits, vegetables, low in fat) and those that viewed TV, had lower maternal education and slept less were positively associated with a dietary pattern that included foods rich in fat and added sugar.⁴¹ Research has also shown that dietary patterns during early childhood can influence the dietary patterns as the child grows up, which is why it is important to establish healthy dietary patterns at a young age.^{51,52}

Food Insecurity

Households experience food insecurity when they do not have access to foods due to economic and social conditions that make it hard to live a healthy active life.⁵³ The USDA administers a large survey that assesses food insecurity annually.⁵³ In 2019, 13.6% of US households who were experiencing food insecurity were ones that had children compared to households who did not have children at 9.3%.⁵⁴ One in three youths between the ages of 12-19 are overweight or obese, which can have negative biopsychosocial consequences and 1 in 5 adolescents are living in a food insecure household in the United States.⁵⁵ Negative relationships can also occur between the

mental well-being of parents and children and their experiences with food insecurity. This study revealed that young children with parents who have a low emotional well-being experience a greater intensity of food insecurity which in turn will affect the child's dietary behavior.

Obesity is a large concern in adults and children who experience food insecurity as they tend to consume foods with inferior nutritional quality.⁵⁶ Children who live in a food insecure household have reportedly lower intakes of FV compared to the consumption of children in food secure homes.^{57,58} Households that experience food insecurity tend to rely on fast, processed, high sugar, high fat foods.^{59,60} Families also experience issues with food availability, accessibility and affordability.⁶¹ One study found that families with very low food security consumed a significantly higher number of servings of carrots and potatoes due to the fact that they are inexpensive and more accessible.⁶² In addition to consuming inexpensive and accessible FV the article found that children who exercise more frequently will consume 1 additional serving of FV each which when compared to children who do not exercise at all. ⁶²

Another study found that rural households who experienced food insecurity had a lack of understanding about the eligibility of food-stamps and food assistance programs that could help increase food consumption as well FV consumption. ²⁸ Children's FV intake is significantly correlated with acculturation level, the more acculturated the child the fewer servings of fruits and vegetables they were consuming. This article found a significant negative correlation between food insecurity and acculturation.⁵⁷

Food access: Many families have limited food access due to a number of factors, including living in a food desert, being food insecure, and having low-income.⁶³ Food deserts are areas in the United States where people have very limited access to healthy and affordable foods.⁶⁴ Previous studies have shown that families who live in food deserts tend to have poor diets that include a lower intake of fiber, and protein and a higher intake of saturated fat, sugars, and sodium.^{51,65} One study suggested that the density of healthier food outlets around the home and proximity to supermarkets was significantly associated with overweight children in the home, demonstrating that food access plays a large role in diet quality and dietary patterns.⁶⁶

Programs to Combat Food Insecurity and Increase Fruit and Vegetable Consumption

Food Assistant Programs: There are many programs that can combat food insecurity including the Supplemental Nutrition Assistance Program (SNAP), Produce Prescription Programs, Nutrition Incentive Programs and community food banks. The National Institute of Food and Technology funds four different grants that fight against food insecurity and hunger, including the community food projects competitive grant program, food insecurity nutrition incentive grant program, the expanded food and nutrition education programs, and agriculture and food research initiative.⁶⁷ These programs help food desert communities by decreasing the risk of type 2 diabetes,⁶⁸ hypertension,⁶⁹ and help build trust between the community members and health care

professionals.^{55,56} One nutrition incentive study revealed that the mean daily servings of total FV consumption had increased significantly from baseline to 6-months.⁷⁰

Produce Prescription Programs (PPR)

Produce Prescription Programs (PPR) are programs that encourage an increase in FV consumption. PPRs are unique among preventative intervention because they use a partnership model of care, the referring physician rewards and positively reinforces repeated health seeking behaviors including consumption of fresh fruits and vegetables.²¹ The Gus Schumacher Nutrition Incentive Program (GusNIP) funds multiple produce prescription programs each year. PPRs are pilot projects for nonprofit organizations and/or State and local agencies to low-income individuals suffering from or at risk of developing diet-related health conditions.²¹ Many PPRs have had success in research with a positive result in increasing the consumption of fruits and vegetables.^{71,72}

PPRs are used in community settings with farmers markets, food banks, universities, and clinical settings. PPRs rely heavily on self-reported data for dietary intake which can be subject to research bias.^{73,74,75} PPRs are also a successful way to decrease food insecurity by working with stores and farms to increase community access to fruits and vegetables.^{74,75} One study focused on determining if these programs increase the mean Healthy Eating Index total score and they found that it increase diet quality and it improved the total HEI score by 4.3 points.⁷⁶ They also found that this program increased vegetable, fruit and whole fruit consumption and lowered the

participants consumption of empty calories, such as sugar and sugar sweetened beverages.⁷⁶

Nutrition Incentive Programs (NI)

Nutrition incentive programs are projects that also increase produce consumption for low-income consumers that participate in SNAP by providing incentives at the point of purchase.²² Incentives can range from a 1:1 return to getting a certain percentage off of the order. Nutrition incentive programs can increase the purchasing power and access to FV for those at risk populations.⁷⁷ Studies have been conducted that show that these programs work with adults and children and have found that there was a significant increase in vegetables.⁷⁸ One study found that NI programs significantly increased FV intake among SNAP participants which closed the 20% gap of FV recommendations and actual intake.⁷⁹

These programs can help reduce the barriers that are associated with shopping for fresh fruits and vegetables including greater spending flexibility and extra budgeting for such produce.⁸⁰ Much like Produce Prescription Programs, NI program participants saw improvements in food insecurity, and diet changes for the better including switching from the processed foods to fresh fruits and vegetables.⁷⁷ These programs are built on the social-ecological model between the individual level, interpersonal level, organizational level, community level, and societal/public policy level.⁷⁷

Home food environment

The home food environment is centered around three main constructs: physical environment,^{81,82} child/parent characteristics^{58,59} and sociocultural environment.⁵⁸ The physical environment includes the availability of nutrient dense foods,⁵⁸ while the sociocultural environment refers to rules related to food, parental encouragement and modeling related to a child's eating habit.⁵⁸ FV consumption can be heavily associated with the home food environment. Research has found that households who exhibit a healthy relationship with food or encourage a child to eat healthier foods have higher FV consumption.⁸³ Research has yet to address whether a food assistant program can help parents increase FV consumption in their household.

Parental modeling: Parental modeling plays a very important role in creating healthy behaviors for children.⁸⁴ Parental modeling includes a purposeful effort to demonstrate healthy food choices and eating behaviors to encourage children to follow the same behaviors.⁸⁵ This type of modeling has been shown to be positively correlated to children's dietary intake and their preferences of fruits and vegetables.⁸⁵ Research shows that children with parents of higher healthy modeling scores had higher HEI scores.⁸⁶ Family meal times are frequently used as a way to put parental modeling into play. The more meals eaten as a family, the higher the FV intake among preschoolers.^{87,88,89} Parental modeling can also be connected to the family environments, as recent studies have indicated that a positive family system is part of the process that establish and promotes healthy behaviors. This study also found that children who were

exposed to authoritative parenting showed the highest levels of improving eating behaviors and food avoidance was decreased.⁹⁰

Sociocultural environment: The sociocultural environment includes cultures, demographics, social networks, and social norms. The more supportive the social norm surrounding fruits and vegetables, the greater the change in FV intake.⁹¹ Social media platforms, like Instagram, may also play a role in what children consume. Influencers that are highly popular have increased children's intake of unhealthy snacks.⁹² A few studies also identified that children 6-11 years of age are more likely to be socially influenced by their peers while eating and will change their ways to conform to social norms regarding food intake.^{93,94} On the other hand, researchers have found that influencers do not have any effect on FV consumption.⁹⁵ Researchers also found that social norm based messages had a small effect on FV consumption and providing messages regarding the health benefits of eating FV had significantly increased the child's consumption.⁹⁶

Food access in home: Food access in the home is associated with FV consumption for kids.⁸⁹ Food access in the home is often determined by a validated questionnaire called the Healthy Home Survey.⁸⁸ For example, one study reported on a ten point scale a median score of 5.0 for vegetables in the house and a score of 7.0 for fruit in the house.⁸⁸ Intake of total FV has been found to be highly correlated with the greatest availability of these foods in the home.⁶⁵ Intervention studies can increase the availability of FV in homes, leading to an increase in total consumption of FV.⁹⁷

Race and ethnicity and differences in dietary consumption

Dietary patterns differ between ethnic groups, for example an increased dietary quality in children is more prevalent in families that have higher educated and higher household income.^{57,98} Previous studies have shown that the diet among Hispanics and those of African origin have unhealthy dietary preferences, including a high intake of salty and calorie-rich foods and a low intake of FV.^{73,99,75} One study suggests that residents in low-income minority and rural areas have less access to a variety of FV at an affordable price.¹⁰⁰

The Youth Risk Behavior Survey (YRBS) allows researchers to monitor health behaviors that contribute to adverse problems such as ADD, and ADHD that are established during childhood and early adolescence including poor social function, and low developmental trajectories in primary school.¹⁰¹ The 2019 survey indicated a significant linear increase in the percentage of students who had eaten vegetables more than once a day among female, male, white, black and Hispanic students.¹⁰²

However, research shows that vegetable consumption only increased in white and black males, and did not change in females and Hispanic children.¹⁰³ The 2017 YRBS looked at state-specific estimates and found that FV consumption was low in Connecticut, Kansas, Louisiana, and New Mexico.¹⁰³ FV consumption were consistently low across demographic groups and high school females.¹⁰³ Researchers also found that on a national level there was a higher number of non-Hispanic black and Hispanic males meeting the recommendation for fruit consumption only.¹⁰⁴ Rural Healthy People 2010

found that cultural tendencies were associated with higher fat and calorie consumption due to the lack of nutrition education.¹⁰⁵

The Behavioral Risk Factor Surveillance System (BRFSS) identifies ways to increase FV consumption in children and their families, especially those in low-income minority areas. In the home environment, community farmers markets are a good solution as they accept federal nutrition assistance benefits.⁷⁸ One study showed that 68% of participants increased their FV consumption and 71% felt that they were more educated about nutrition and healthy eating.¹⁰⁶ During the school months, schools can join farm to school and farm to early childhood education (ECE) programs to educate the children and introduce them to fruits and vegetables.^{100,107} There are many studies that examine the difference in dietary patterns between ethnic groups as well as ways to combat poor dietary patterns in such areas.

Urban & Rural Areas Fruit and Vegetable Consumption

The United States Census Bureau classifies US communities as either urban or rural areas. Urban establishments can be divided into two parts, urban areas are those with 50,000 or more people, while urban clusters are considered area with at least 2,500 but less than 50,000 people.²³ Rural areas encompass the entire population, all of the housing and establishments and the remaining territory not included within an urban area.²³

FV intake in such areas is widely dependent on the density of healthy food retail outlets in the neighborhood.¹⁸ One study suggests that families who reside in urban areas

will not have access to a garden as a source of FVs, while families who live in rural areas may not have a large variety of FV in their local grocery store.¹⁰⁸ Research also suggests that child and adults in rural areas do not meet the recommended amount of fruits and vegetables.^{109,110}

Urban Food Desert: There are a multitude of food deserts across rural and urban areas, thus, making it difficult to access healthy and affordable food. Families that are located within urban areas or inner cities usually have to travel quite a distance to get to a large chain supermarket to find fresh FVs because they are often only located in the suburbs or at the far edge of cities.^{111,112} If a family lacks proper transportation, they may be forced to purchase food at a small or a medium sized grocery stores where healthy food is commonly sold at a premium compared to large chain stores or, even worse, the store lacks healthy selections altogether.^{111,113,114} For example, one study found that the distance to the nearest supermarket was similar among high-income African-American and white neighborhoods in metropolitan Detroit, while the nearest supermarket was significantly farther away from the low-income neighborhoods.¹¹⁵

One study focused on providing healthy foods at corner stores in low-income Urban areas that were a part of a Nutrition incentive program. They found that participants reported eating more FV and trying new fruits and vegetables since participating in the Food Bucks Program.¹¹⁶

Rural areas: Studies show that children who live in rural areas have lower fresh FV intake because of limited household availability due to the lack of access to fresh

fruits and vegetables in these communities.^{83,84,117} Largely, it is difficult to purchase fresh FV in rural environments because retail food environments are just not accessible to families. Fittingly, one study found that rural participants consumed less fruits and vegetables than their urban counterparts due to their physical distance from the grocery stores.¹¹⁸ Thus, showing that food accessibility is important to improving FV consumption in rural communities and households. A study focused on rural schools and how to improve FV intake and found that campaigns that had fun, energy and color of the produce increased students likelihood of picking up that piece of fruit or vegetable.¹¹⁹

Many studies have also explored different programs aiming to increase FV consumption through interventions like CHANGE, 5-A-Day Power Plus Program and TEENS.^{120,121,122} The Creating Healthy, Active and Nurturing Growing-up Environments (CHANGE) study focused on changing the school diet and increasing physical activity.¹²⁰ The 5-A-Day Power Plus Program was focused on social learning theory and consisted of 4 components, behavioral interventions, parental involvement, school food service changes and industry involvement.¹²¹ The Teens Eating for Energy and Nutrition at School (TEENS) study focused on developing and evaluating school and family linked intervention strategies to promote students' consumption of FV and lower fat snacks.¹²² Research on FV consumption among children who reside in rural areas is sparse and mainly focuses on the rate of obesity and food access.

There is an abundance of research that examines the relationship between FV consumption and rural and urban areas in adults. Most studies show that food access is a main factor of why rural households consume less FVs.⁸¹⁻⁸⁷ However, there is very

limited data examining consumption of FVs in children from both rural and urban households.

Summary

In summary, FV consumption is generally poor in adults, children and in those who experience food insecurity as well as those who live in areas with limited access to retail grocery stores. A scarcity of community supermarkets, inadequate transportation and traveling long distances restricts access to retail outlets that carry fresh fruits and vegetables in both rural and urban environments. Multiple factors outside geographic location influences fresh FV consumption in children for example, parent or adult modeling behaviors in addition to the home environment, familial race and ethnicity, and cultural norms. Moreover, parental education and income weight heavily on food security. In total, these factors regulate a family's experience with consistent, adequate nutrition, or food security, thereby shaping a child's feeding patterns, specifically their consumption of fruits and vegetables.

Furthermore, there has been an abundance of research focused on the intervention of increasing FV consumption, examining the various reasons consumption is low in children as well as comparing urban versus rural consumption in adults. However, there are very few studies that compare rural and urban families and their consumption of FVs. This thesis is going to explore the relationship between food insecurity and consumption of FVs in caregivers, and if that relationship differs among rural and urban areas.

CHAPTER 3

METHODS

Study Design

This was a cross sectional study that determined if there was a relationship between food security and consumption of FVs in caregivers (parents, grandparents, step parents, etc.) and how that relationship varied between rural and urban areas. Analyses were completed on a group of participants that partook in NI programs from the GusNIP grant. Trained employees collected the data for in-person surveys and provided literacy support as needed. Inclusion criteria was caregivers with children <18 years of age at GusNIP-funded sites that are participating in NI, receiving SNAP benefits, and living in low-income areas. Exclusion criteria included adults with no children and adults with children over the age of 18. Only those who answered all questions in the baseline survey were evaluated (n=3,455). The UNMC Institutional Review Board Approved this study.

Measures

Fruit and vegetable intake. The dependent variable, daily frequency of FV of the caregivers, were assessed through a 10-item screener from the National Cancer Institute's Dietary Screener Questionnaire (DSQ)¹²³ that asked consumers about the frequency of foods and beverages consumed in the past month; the 10 items were: green salad, non-fried vegetables, cooked beans, fruit, fried potatoes, other nonfried potatoes, 100% fruit juice, pizza, other tomato sauce, and salsa. Response options included 11 frequencies ranging from 'never' to '6 or more times per day.'¹²³ To calculate monthly intake

frequencies of FVs, all responses were converted to daily frequency. For example, for the response option ‘2-3 times last month,’ the median (2.5) was taken and was compared to the conversion sheet and it was determined that it would be 0.083 times per day.^{124,123} The primary variable examined was total FV intake as times per day. Three sensitivity analyses were conducted that examined 1) FV with no potatoes, 2) FV with no juice, and 3) FV with no potatoes or juice.

Food insecurity. Questions were adapted from the USDA household food security survey.

Questions asked if the participant has to worry about food; if the food the family purchased ran out and there was not enough money to get more; if meals were limited to only a few kinds of cheap foods; if they weren’t able to eat a balanced meal; if they had to eat less due to not having sufficient money for food and if the size of their meals been reduced because their family did not have enough money for food. The response options for these questions ranged from ‘a lot’, ‘sometimes’, and ‘never’.

Responses of ‘often’ or ‘sometimes’ on questions were coded as yes. The sum of the affirmative responses becomes the participant’s raw score. A raw score of 0-1 has high food security, a raw score of 2-4 have low food security and a raw score of 5-6 very low food security. Therefore, raw scores between 2-6 indicate that participant is living with food insecurity.¹²⁵ The raw scores were coded as 0 for food security and 1 for food insecurity.

Locale. To determine if the participant lives in an urban or rural area, zip codes were analyzed using the Rural Health Information Hub. Once the zip code was entered, the

report was run and researchers looked at the common rural definitions, looking at the census 2010 percent rural.¹²⁶ This was double checked by looking at the RUCC classification of metro or nonmetro. If the classifications did not match the zip code would be defaulted to what the census says.¹⁰⁷ If the population was more than 50% rural it was classified as rural. If the population was less than 50% rural it was classified as urban.¹²⁶ The U.S. Census Bureau has two definitions of urban including Urbanized areas which are areas that include 50,000 or more people and urban clusters are areas of at least 2,500 and less than 50,000 people.¹²⁷

Covariates. The covariates that were also collected and analyzed included age, sex, race and ethnicity, the site of data collection. Sex was coded as male (0) and female (1). Race was split into 5 codes: White (1), Black (2), Asian (3), American Indian and Alaskan Native (4) and 2 or more/ other (5). Hispanic was kept as its own covariate with 0 as non-Hispanic and 1 as Hispanic. There were five sites total: Fair Food Network (1), Nebraska Community Fund (2), WA State Department of Health (3), Market Umbrella (4), and Farmers Market Fund (5).

Statistical Analyses

Bivariate analyses (t-tests and chi-square tests) between food insecurity status, gender, race, Hispanic, locale, age and FV consumption were examined. Urban vs. rural locale was examined as an interaction, but with null findings. As such, mixed linear models were used to assess the relationship between FV consumption (in daily frequencies) and food insecurity status, adjusted for urban and rural locale, sex, race,

Hispanic and age and FI, clustering at the site level. To run these analyses, Stata 15 statistical software was used. Statistical significance was determined at, $p < 0.05$.

CHAPTER 4

RESULTS

Participant Demographics and Key Variables

In total, 3455 caregivers were included in analyses and the sample was 57.8% white and 75.2% non-Hispanic (Table 5). Food insecurity was reported among 78% of households. The majority of the caregivers resided in an urban area (93.1%). The average FV consumption for all caregivers was 4.83 ± 0.06 times per day. There were significant differences between gender, race, age, and each of the child FV consumptions variables and food security status ($p < 0.001$).

Table 5.
Participant Demographics and Key Variables (n=3,455)

	Total Participants	Food Secure	Food Insecure	P Value
	% (n)	% (n)	% (n)	
Gender				
Male	46.2 (1,615)	39.8 (296)	47.9 (1,319)	<0.001
Female	53.8 (1,882)	60.2 (447)	52.1 (1,435)	
Race/Ethnicity				
White	57.8(2,037)	61.4 (466)	56.8 (1,571)	<0.001
Black	25.9 (914)	14.5 (110)	29.1 (804)	
2+/Other	8.5 (298)	14.9(113)	6.7 (185)	
American Indian or Alaska Native	4.2(148)	4.9 (37)	4.0 (111)	
Asian	3.6(126)	4.4 (33)	3.4 (93)	
Hispanic				
Not Hispanic	75.2 (2,653)	74.3 (564)	75.5 (2,089)	0.511
Hispanic	24.8(874)	25.7 (195)	24.5 (679)	
Locale				
Urban	93.1 (3,251)	94.0 (707)	92.9 (2,544)	0.276
Rural	6.9 (240)	5.9 (45)	7.1 (195)	
	Mean +/- SD	Mean +/- SD	Mean +/- SD	P value
Age	33.7+/- 0.13	35.7+/-0.32	33.3+/-0.14	<0.001
FV	4.83+/-0.06	5.29+/-0.12	4.71+/-0.07	<0.001
FV No potatoes	3.93 +/- 0.05	4.48 +/-0.10	3.78 +/-0.06	<0.001
FV No Juice	4.31 +/- 0.05	4.68 +/-0.10	4.21+/-0.06	<0.001
FV No Juice No Potatoes	3.41 +/- 0.44	3.86 +/-0.09	3.28 +/-0.05	<0.001

Mixed Linear Regression Analyses

The mixed linear regression analyses showed food insecurity is associated with FV consumption no matter how FV consumption was examined (Table 6). When examining total FVs, there is a 0.5 decrease in daily frequency of FV consumption in

caregiver's households with food insecurity (95 % CI:-0.81,-0.22). Age was always associated with FV consumption with the exception of FV consumption no juice or potatoes. Urban and rural was associated with total FV consumption only. Consistently, there were significant associations with race and FV consumption as Black and Asian families were associated with lower FV consumption as compared to white households no matter how FV consumption was assessed ($p < 0.05$). For example, there is a 0.83 decrease in FV not including juice consumption in Black family households (95% CI: -1.08,-0.57) and a 0.6 decrease in consumption in Asian family households (95% CI: -1.18, -0.01). Age was also inversely associated with total FV consumption and FV consumption not including juice ($\beta = -0.03$, 95% CI:-0.04,-0.01; $\beta = -0.02$, 95% CI:-0.04,-0.01, respectively)

Table 6
Mixed linear regression examining differences between Fruit and Vegetable consumption and Food Insecurity among Nutrition Incentive participants (n=3,455)¹

	FV			FV No Potatoes			FV No Juice			FV No Juice or Potatoes		
	β Value	CI (95%)		β Value	CI (95%)		β Value	CI (95%)		β Value	CI (95%)	
Food Insecurity	-0.51	-0.81	-0.22	-0.60	-0.84	-0.35	-0.40	-0.66	-0.13	-0.48	-0.70	-0.26
Urban	0.51	0.04	0.99	0.31	-0.08	0.70	0.37	-0.06	0.79	0.16	-0.18	0.50
Sex	-0.06	-0.30	0.18	0.03	-0.17	0.23	-0.04	-0.26	0.18	0.08	-0.13	0.23
Race												
White (1)	Ref.			Ref.			Ref.			Ref.		
Black (2)	-0.96	-1.25	-0.68	-0.84	-1.07	-0.61	-0.82	-1.08	-0.57	-0.70	-0.90	-0.49
Asian (3)	-0.81	-1.46	-0.16	-0.71	-1.25	-0.18	-0.60	-1.18	-0.01	-0.49	-0.97	-0.02
Am.	-0.54	-1.14	0.06	-0.37	-0.87	0.13	-0.33	-0.87	0.21	-0.16	-0.60	0.28
Indian & Alaskan Native (4)												
2+other (5)	0.20	-0.26	0.66	0.27	-0.11	0.65	0.23	-0.18	0.65	0.30	-0.04	0.63
Hispanic	0.01	-0.27	0.30	0.11	-0.13	0.34	-0.00	-0.14	0.36	0.09	-0.12	0.30
Age	-0.03	-0.04	-0.01	-0.02	-0.03	0.00	-0.02	-0.04	-0.01	-0.01	-0.02	0.00

1. Models are adjusted for sociodemographics, food insecurity, and clustering at the site level

CHAPTER 5

DISCUSSION

The purpose of this study was to determine if there is a relationship between food insecurity and consumption of FV in caregivers who participated in the GusNIP grant Nutrition Incentive Program. We also explored if that relationship varied between rural and urban locales. This study sought to address gaps in the literature regarding FV consumption among caregivers who reside in urban and rural areas and provide an idea of what consumption is like in these households. Participants were from five different US states, including Nebraska (Nebraska Community Fund), Washington (Department of Health), Michigan (Fair Food Network), Louisiana (Market Umbrella), and Oregon (Farmers Market Fund). This study found that FV consumption was associated with food insecurity in all ways that FV consumption was examined. The study found that urban and rural locale did not impact the association. These findings can be used to inform future research with caregivers' FV consumption and their relationship with food insecurity and provide future studies with an idea of how locale plays a role in their consumption of fruits and vegetables. This study sets the stage for looking how caregiver consumption can affect their child's intake. Researchers can also see how caregivers engage with these nutrition incentive programs.

In 2021, the USDA reported that 13.6% of households are food insecure.¹²⁸ This study reported that 78% of caregivers households are food insecure (47.9% of males and 52.1% of females in the household are food insecure). These numbers are inflated due to the small sample size compared to the USDA that was reporting on a national level. The

current study showed a statistically significant relationship between food insecurity and FV consumption in all ways that FV consumption was assessed, consistent with previous research. Past literature shows that adults with food insecurity have a poor intake of FV consumption and intake decreases with every decrease in financial status.¹²⁹ For example, a study by Lee, Kubik, and Fulkerson found that food insecure households reported low HEI and these households have fewer cups of whole fruit, and more sugar-sweetened beverages.⁶⁰ A study conducted in 2009 found that food insecure households consumed 0.58 servings of less fresh fruit than food secure households per day on average.⁵⁷ Past literature and this study indicate that food insecurity is negatively correlated to a variety of different groups of FV consumption.^{108,57} The current study showed that there was a 0.51 less of a daily frequency of FV in food insecure households with children, as well as a 0.7 decrease in daily frequency of FV not including juice or potatoes in food insecure households with children. High prevalence of food insecurity and the association with lower FV consumption indicates that nutrition programs, such as those that incentivize the purchase of FVs, are needed to help bring fresh produce into households, provide nutrition education, and increase the consumption of FVs in both caregivers and their children.

It is possible that the home food environment could be affected by nutrition incentive programs. This study shows baseline data for caregivers (n=3455) and shows that caregivers consume FVs their household which can increase modeling of FV intake, which has been shown to be positively correlated to children's dietary intake.⁸⁵ Nutrition incentive programs, may lead to an increase in food access.⁹⁷ For example, one study

found that infants and mothers living in a home with greater access to FV tended to consume more FV.⁹⁷ Nutrition incentive programs have a goal to increase nutrition education and increase access to FV.⁷⁷ BRFSS findings indicate that 71% of participants in nutrition incentive programs felt more educated than they did prior to the food incentive program.⁷⁸ In the current study, the frequency of consumption was low in both food secure and food insecure households; although, food insecure caregivers reported significantly lower intake. These findings suggest that there is a need to increase FV access and consumption, especially among food insecure caregivers.

Differences were observed in FV consumption by race. Studies conducted previously have mixed results regarding the role that race plays in FV consumption. Some studies identified that Hispanic and African American households have a high intake of salty and calorie-rich foods and low intake of FV.^{86,100,99,88} Another study found that vegetable consumption increased in white and Black students but did not increase in females or Hispanic students in an intervention study.¹⁰³ However, in this study, it was found that only Black and Asian races reported significantly lower FV consumption as compared to White households. Potential reasons why FV consumption is lower in these populations include food access,⁸⁹ education level of the caregivers⁵⁰, and parental modeling.⁸⁵ Research has shown that food assistant programs can help increase FV consumption.⁷⁰ Future studies should determine if Nutrition Incentive programs can help increase FV consumption in these populations, which will help researchers determine how race affects FV consumption in the context of food insecurity.

This study found only a relationship between FV consumption and locale but not for any other way FV consumption was examined, which may be explained by the relative low prevalence of rural participants included in the study. However, there are a variety of programs that affect FV intake in the rural population for example, different environments, a NI program, or a PPR can increase consumption of FV. A study focused on schools found that colorful campaigns of FV increased the likelihood of children in rural areas picking up FV for a school snack.¹¹⁹ The CHANGE study focused on school environments and physical activity. Its primary intervention was creating healthy active and nurturing environments focused solely on rural areas.¹¹⁹ TEENS is another program that is focused on developing and evaluating school and family linked intervention strategies that promote student consumption of FV and lower fat snack.¹²² Nutrition intervention programs are also providing FV and attempting to create a healthy nutritious dietary pattern.⁷⁷ These intervention studies plus a nutrition incentive program could lead to a greater understanding of rural consumption in children and how these programs affect the home food environment.

Nonetheless, findings indicate that locale should continue to be examined more thoroughly in future research. Like previous research, our finding may indicate that adults in rural areas were less likely to consume the recommended amount of FV.¹⁵ Previous studies have found that FV intake largely depended on the number of food retailers in and around the neighborhood.¹⁸ Another study identified that parents who reside in rural or urban areas do not meet the recommended amount of FV intake.^{130,82} Many studies focused on why consumption was so low in rural areas and concluded that food access is

a primary driver. For example, one study suggested that the home food environment may explain the disadvantaged neighborhoods and while those who reside in rural areas will have access to FV via a garden but not in their local small grocery store.^{96,18}

The scientific literature indicates that transportation is a central problem to obtaining fresh produce for people who reside in both rural and urban areas.^{112,17} This study did not focus on transportation but future research should determine if transportation would be a confounder variable, potentially affecting the results. Urban and rural low-income areas tend to be in the middle of a food desert, leading to transportation issues and forcing families to purchase FVs at a premium price from a small or medium sized grocery store.^{111 112} Food access programs have had success in these areas and increased FV consumption.^{113,114} A study on food access programs found that adult participants reported increased FV intake, and adult participants had also tried new fruits and vegetables.¹¹⁶ However, very few studies have examined the impact of these programs on children's intake of FVs and this study only complies adult cross-sectional data which cannot be used to determine causality. Future research should examine if the success of these programs varies by urban vs rural locale and examine the impact of the FV incentive programs on all family members.

Study strengths and limitations. Strengths of this study include addressing the gaps in the literature regarding the relationship between household consumption of FVs and rural and urban locale. The use of validated measures to assess FV intake, food security status, and locale using zip codes provide strength to the data collected. This study provides

insight into the food insecure population of interest and provides a diverse sample from 5 different states across the United States.

However, study limitations need to be considered when examining the results. In this cross-sectional study, causality cannot be inferred, as participant responses were only collected at one point rather than over a period of time; this excludes the possibility to show cause and effect. The study participants are a convenience sample from the GusNIP program who are enrolled in a NI program, which can limit the generalizability as it is not a national sample and can lead to recruitment selection bias. In addition, there was limited variability in the number of participants that were considered rural, which may have resulted in the null findings with locale. Many of the questions in the survey were subjective and can leave errors for personal interpretation or having to rely on memories to recall information which can lead to recall bias and social desirability. Caregivers also had the opportunity to complete the survey online or in-person with assistance; there is a possibility that participants may have chosen the online version with limited literacy.

CHAPTER 6

CONCLUSION

This cross-sectional study identified participants enrolled in nutrition incentive programs from the GusNIP Grant to assess the relationship between food insecurity and FV consumption and how that relationship varied based on urban or rural locale. The hypotheses for this study were proven to be true. The results supported the first hypothesis, which stated that food-insecure caregivers would have a lower consumption of fruits and vegetables. On average, participants from this study did not consume the recommended amount of FVs daily; consumption was significantly lower among caregivers who reported food insecurity. Food insecurity was related to FV consumption in every way FV consumption was examined. The second hypothesis stated that the rural population would have a great intake of FV then the urban population . There are no differences in the FV by locale among the caregivers. However, the urban and rural locale was significantly significant in FV consumption which was due to the low variability of rural households.

Programs like GusNIP's Produce Prescription Programs and Nutrition Incentive Programs may be ways to increase FV consumption in food insecure communities. Since this study was unable to examine differences in children's FV intake by locale, future studies should consider assessing the impact of urban vs rural environments on children's FV intake as their intake is likely impacted not only by the home food environment but also school and social environments. This study sets the stage for a unique perspective of looking at how caregivers' intake can influence their children's intake of FVs. Further

research should address how caregivers' intake affects children's FV consumption for food insecure households and how that differs from locale.

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