ABSTRACT

Nutrition Self-Efficacy of
Veggie Van Customers in Central Texas

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Obesity is a growing public health issue nationally and worldwide. Eating behavior may be a modifiable risk factor for obesity. Low nutrition self-efficacy and lack of access to healthy foods may inhibit healthy eating. Implementation of mobile produce markets may be effective in improving access to healthy foods, but little is known about mobile market users. Mobile produce market users of the Veggie Van in McLennan County, TX (n=192) were asked about government benefit eligibility, education levels, and nutrition self-efficacy. Nutrition self-efficacy of mobile produce market users was moderately high. In this study, race/ethnic minority market users had higher overall nutrition self-efficacies, after adjusting for age, sex, and socioeconomic status. Overall, mobile produce markets may be effective in improving access to healthy foods nationally. Further, use of mobile produce markets could improve eating behaviors and decrease obesity rates in the United States.

Nutrition Self-Efficacy of Veggie Van Customers in Central Texas

by

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A Thesis

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CHAPTER ONE

Introduction

Purpose and Significance

Obesity is a growing public health issue both in the United States and worldwide. Worldwide, over 600 million people were obese in 2014, and the rate of obesity has almost doubled since 1980. Nationally, the Centers for Disease Control and Prevention (CDC, 2015) estimates that 34.9% of Americans are obese. Increases in obesity have both medical and financial consequences. Obesity is associated with many different chronic diseases, including cardiovascular disease, stroke, type 2 diabetes, and certain kinds of cancer (CDC, 2015).

Worldwide, 23% of ischemic heart disease, between 7% and 41% of cancer burdens and 44% of type 2 diabetes are related to overweight/obesity (WHO, 2015). These chronic diseases are also some of the leading causes of preventable death in the United States (CDC, 2015). Obesity and associated medical conditions have a high financial burden. In 2014, the individual cost of obesity was $1,901 annually, which accounted for $149.9 billion at the national level.

Unhealthy eating behavior may be a modifiable risk factor for obesity. According to the United States Department of Agriculture's (USDA, 2015) dietary guidelines, a healthy diet includes whole grains, fat-free/low-fat dairy, a variety of protein sources (including animal sources like lean meats and seafood, soy products, legumes, nuts and seeds), a variety of fruits and vegetables, and oils from plants, while limiting *trans* fats, sodium, and added sugars.

An individual's physical environment may promote or impede his or her healthy eating behaviors. Limited access to healthy foods or high prices of fresh fruits and vegetables may influence an individual's healthy eating behavior (Dijkstra et al., 2015). A food desert is one way to conceptualize access to healthy food. A food desert is defined as a low-income census tract wherein at least 33% of the population lives more than 1 mile from the nearest grocery store in an urban area or 10 miles from a grocery store in a rural area (Tolzman, Rooney, Duquette, and Rees, 2014). Individuals who live in food deserts may have reduced access to healthy foods, which could limit healthy eating choices.

One potential strategy to increase or improve access to healthy foods is a mobile produce market. A mobile produce market is a mobile vendor where fresh fruits and vegetables are sold. Typically, mobile produce markets operate in areas that are considered food deserts. Examples of mobile produce markets around the United States include: Freshest Cargo (California), Red Stick Mobile Farmer's market (Louisiana), Arcadia Mobile Market (Washington, DC) and Go Fresh Mobile Market (Massachusetts). The placement of mobile produce markets has been has been evaluated (Li, Cromley, Fox, Horowitz, 2014), but little is known about mobile produce market users.

The Veggie Van is a program that was implemented in the spring of 2015 by World Hunger Relief, Inc. (WHRI), a Christian organization based in Elm Mott, Texas (Veggie Van, n.d.). The Veggie Van is a mobile produce market from which WHRI employees and volunteers sell fresh fruits and vegetables in food deserts in McLennan County, Texas. The purpose of this program is to alleviate food deserts and hunger by improving access to healthy foods among McLennan County residents.

Mobile produce market customers are not well described. Although the Veggie Van was designed to eliminate environmental barriers to healthy eating like access to food, individual characteristics such as self-efficacy may affect the use of the Van program. Self-efficacy is defined as one's belief in his or her ability to succeed in specific situations or to accomplish specific tasks (Bandura, 1977). Individuals with higher self-efficacy are more likely to make necessary efforts to achieve a desirable outcome, regardless of opposing factors or barriers (Cha et al., 2014). Although self-efficacy is not the only factor that influences nutrition-related behaviors, understanding nutrition self-efficacy may help researchers design nutrition-related interventions to improve Veggie Van usage. These interventions, which if expanded to other areas of the country, could potentially increase nutrition self-efficacy and the proportion of Americans that meet the USDA guidelines for fruit and vegetable consumption, therefore mitigating rising obesity rates in the United States (Gase, Glenn, & Kuo, 2015; Guntzviller, King, Jensen, & Davis, 2016). Thus, the purpose of this study is to examine nutrition self-efficacy and the association between socioeconomic status and nutrition self-efficacy among Veggie Van users.

Definitions of Terms

Terms used throughout Nutrition Self-Efficacy of Veggie Van Customers in Central Texas are defined in Table 1 on the next page.

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Table 1

Definitions for terms used throughout Nutrition Self-Efficacy of Veggie Van Customers in Central Texas

Self-Efficacy	One's belief in his or her ability to succeed in specific situations or to accomplish specific tasks
Nutrition Self-Efficacy	One's belief in his or her ability to perform a specific nutrition-related behavior in specific situations
Food Desert	A low-income census tract wherein at least 33% of the population lives more than 1 mile from the nearest grocery store in an urban area or 10 miles from a grocery store in a rural area
Mobile Produce Market	A mobile vendor where fresh fruits and vegetables are sold. Typically, mobile produce markets operate in areas that are considered food deserts
Veggie Van	A mobile produce market that operates in McLennan County, Texas

Study Overview

Veggie Van customers throughout McLennan County were invited to participate in a survey. Eligible participants were English-speaking adults aged 18 years or older who provided verbal informed consent to participate in the survey. Twelve graduate students and twenty-five undergraduate students were trained to administer the Veggie Van Questionnaire. Data collectors verbally administered the Veggie Van questionnaire, which focused on the individual sociodemographic characteristics, healthy eating behaviors, and barriers and beliefs about nutrition and food purchasing. Once a

participant had completed the Veggie Van Questionnaire, he/she received a $5 "Veggie Bucks" voucher to be used at the Van for the future purchase of fruits and vegetables.

Research Questions and Hypotheses

1) What is the nutrition self-efficacy of Veggie Van users?

2) What is the association between socioeconomic status and nutrition self-efficacy among Veggie Van users?

We hypothesize that participants with lower socioeconomic status will have lower levels of nutrition self-efficacy compared to participants with higher socioeconomic status.

Potential Limitations

1) This is a cross-sectional study, and as such, we cannot assess how healthy eating behaviors change over time.

2) Survey measures are self-reported by the participant.

Delimitations

1) Individuals must be English-speaking Veggie Van customers to participate in the survey.

2) Individuals must be at least 18 years of age to participate in the survey.

Public Health Significance

Describing the association between socioeconomic status and nutrition self-efficacy is critical for understanding Veggie Van customers in McLennan County, Texas. Ultimately, this information will be used to design a healthy eating intervention for Veggie Van users to increase the consumption of fruit and vegetables and decrease

obesity rates in central Texas. Nationally, mobile produce markets may be a model for eliminating food deserts and improving healthy eating behaviors in the United States.

CHAPTER TWO

Literature Review

Literature Review Introduction

Obesity is a growing public health issue worldwide. Obesity rates have almost doubled since 1980 (WHO, 2015). Over 600 million people, or 13% of the worldwide population, were obese in 2014 (WHO, 2015). Nationally, the Centers for Disease Control and Prevention (CDC, 2015) reports that 34.9% of Americans are obese.

Obesity disproportionately affects Americans based upon their race and ethnic groups and ages, as well as their geographic locations (CDC, 2015). According to a study in 2014, 48.4% of non-Hispanic blacks in the U.S. were obese, which was the highest among any ethnicity (Flegal et al., 2016). The researchers reported that Hispanics had the second-highest obesity rates in the U.S. (42.6%), followed by non-Hispanic whites (36.4%), and non-Hispanic Asians (12.6%). The researchers also studied the rates of obesity among U.S. adults according to age group. The researchers reported that obesity was highest among adults 40-59 years old (41%), compared to those 20-39 years old (34.3%) and those 60 and older (38.5%). Nearly 17% of children and adolescents aged 2-19 years are considered obese (CDC, 2016). Adults who live in the southeast region of the United States have higher obesity rates than those who live in other regions. In 2015, Louisiana, Mississippi, and Alabama all had obesity rates of 36.2%, 35.6%, and 35.6%, respectively. The states with the lowest obesity rates included Montana, Hawaii, and Colorado, which had obesity rates of 23.6%, 22.7%, and 20.2%, respectively

Obesity has both financial and medical consequences. Kim and Basu (2016) estimated that the annual cost of obesity at the individual level was $1,901 in 2014, which accounted for $149.9 billion in total healthcare costs. Chronic diseases associated with obesity contribute to many of these costs. Obesity is correlated with many chronic diseases, including cardiovascular disease, stroke, type 2 diabetes, and certain kinds of cancer (CDC, 2015). These chronic diseases are some of the leading causes of preventable death in the U.S. (CDC, 2015). The World Health Organization (WHO) attributes 44% of the type 2 diabetes burden, 23% of ischemic heart disease, and between 7% and 41% of cancer burdens to worldwide overweight and obesity.

The complex relationship between obesity, race and ethnicity, and socioeconomic status differs for men and women (CDC, 2015). Women with higher incomes and with college degrees are less likely to be obese than women with lower income and education levels (CDC, 2015). Men who identify as non-Hispanic black or Mexican-American and those with higher incomes are more likely to be obese than men with low incomes (CDC, 2015). In children and adolescents, obesity levels may be associated with family income levels and the head of household's education level (CDC, 2016).

Healthy eating behaviors may be a modifiable risk factor for obesity in the United States. The United States Department of Agriculture (USDA, 2015) reports that healthy eating may prevent or decrease obesity at the individual level. According to the 2015-2020 Dietary Guidelines for Americans (USDA, 2015), a healthy eating pattern includes a variety of fruits and vegetables, whole grains, fat-free/low-fat dairy, a variety of protein foods (e.g. seafood, lean meats, poultry, eggs, legumes, soy products, nuts, and seeds), and oils from plants. An individual who follows that Dietary Guidelines will limit added

sugars, saturated fats, *trans* fats, and sodium. Less than 10% of an individual's daily calories should come from added sugars, less than 10% of an individual's daily calories should come from saturated fats, and sodium intake should be limited to less than 2,300 mg per day (USDA, 2015).

Fruit and vegetable consumption is an important component of a healthy diet. According to the United States Department of Agriculture recommendations, women aged 19-30 years should consume 2.5 cups of vegetables and two cups of fruit per day. Men aged 19-30 years should consume three cups of vegetables and two cups of fruit per day (USDA, 2015). Less than one-third of adults in the United States consume the recommended amount of vegetables daily, and less than 25% of adults consume the recommended amount of fruits daily (USDA, 2015).

Healthy eating can be conceptualized as both a preventative factor and a treatment factor for health-related diseases. Healthy eating is a preventative factor for cardiovascular disease (Sotos-Prieto et al., 2015) type 2 diabetes (Ley et al., 2016), and major depressive disorder (Jacka & Berk, 2013). Healthy eating is also an effective method of treatment for nonalcoholic fatty liver disease (Dongiovanni, Lanti, Riso, & Valenti, 2016) and type 2 diabetes (Franz, 2016) Despite the well-documented benefits of a healthy diet, the majority of Americans fail to follow a healthy eating pattern.

Although fruit and vegetable consumption may improve an individual's health, many barriers can inhibit healthy eating behavior. In 1977, Urie Bronfenbrenner first described the Ecological Framework for Human Development, known today as the Social Ecological Model (Bronfenbrenner, 1977). Bronfenbrenner described five hierarchical levels that may influence an individual's behavior: individual, microsystem

(interpersonal), mesosystem (community), exosystem (organizational), and macrosystem (policy). According to Bronfenbrenner, factors affecting healthy behaviors can occur at any of these five levels. These factors are described in Figure 1 below.

*Some groups may fit within multiple levels of this model.

Figure 1. The Social Ecological Model (CDC, 2013)

Many environmental factors influence health-related behavior. Environmental barriers may stem from the interpersonal, community, organizational, or policy levels of the Social Ecological Model (Bronfenbrenner, 1977). For example, at the organizational level, food prices can influence healthy eating behaviors, because high prices of fruits and vegetables have been reported as a frequently perceived barrier to fruit and vegetable consumption (Dijkstra et al., 2015). Researchers have also described lack of community resources and the influence of family and friends as barriers to healthy food consumption. Tolzman, Rooney, Duquette, and Rees (2014) studied barriers to accessing healthy foods in a food desert. They defined a food desert as a low-income census tract, wherein at least

33% of the population lives more than 1 mile from the nearest grocery store in an urban area or 10 miles from a grocery store in a rural area. Over 33% of households had inadequate access to healthy foods in the area surveyed. The influence of peers is a potential interpersonal barrier to fruit and vegetable consumption (Fitzgerald, Heary, Kelly, Nixon, & Shelvin, 2013). For example, Fitzgerald et al. (2013) reported that adolescents who had peers that encouraged the consumption of sweets, unhealthy snacks, and desserts were more likely to consume unhealthy foods than adolescents who did not have peers encouraging unhealthy food consumption.

Individual factors also influence health-related behavior. For example, lack of knowledge of the nutritional value of foods (Pem, Bhagwant, & Jeewon, 2016) and negative attitudes toward healthy eating (Wang et al., 2016) have been described as potential barriers to fruit and vegetable consumption. An individual's self-efficacy may also influence health-related behaviors (Bandura, 1977). Bandura defines self-efficacy as one's belief in his/her ability to succeed in specific situations or to accomplish specific tasks. Self-efficacy has been associated with healthy eating (Gase, Glenn, & Kuo, 2015), regular exercise (Pei, Wang, Sun, & Zhang, 2016), and type 2 diabetes management (Gunggu, Thon, & Whye Lian, 2016).

Increasing an individual's self-efficacy may also help improve eating behavior. Cha et al. (2014) note that individuals with higher self-efficacy are more likely to make necessary efforts to reach a desirable outcome despite opposing factors. A large proportion of Americans do not consume the recommended daily amount of fruits and vegetables (USDA, 2015), therefore understanding and improving nutrition self-efficacy

may increase fruit/vegetable consumption and decrease obesity rates in the United States (Gase, Glenn, & Kuo, 2015).

Self-efficacy is a widely used concept, but less is known about nutrition self-efficacy and its relationship to socioeconomic status. Therefore, the purpose of this literature review is to identify and describe previous research concerning the association between socioeconomic status and nutrition self-efficacy.

Literature Review Methods

Multiple search engines, including PsycINFO, PubMed, and Academic Search Complete, were used to acquire information about the association between socioeconomic status and nutrition self-efficacy. Combinations of the terms "socioeconomic status," "social class," "healthy eating," "nutrition," "food security," and "self-efficacy" were used to search the literature. Because research concerning the relationship between socioeconomic status and nutrition self-efficacy is limited, no date restrictions were used in the search.. The search yielded 259 articles from peer-reviewed journals. Of these articles, 246 were eliminated due to irrelevance and repetition. Articles were deemed irrelevant if nutrition self-efficacy and socioeconomic status were not variables studied and/or if all research participants were under the age of 18.

After the search was complete, articles were compiled into four categories. Seven articles were used to examine the effects of self-efficacy on healthy eating. Two articles were used to examine the effects of socioeconomic status on healthy eating and self-efficacy. Two articles were used to examine the effects of health literacy on nutrition self-efficacy. Lastly, two articles were used to examine the effects of food security on nutrition self-efficacy.

Effects of Nutrition Self-Efficacy on Healthy Eating

Nutrition self-efficacy influences healthy food acquisition. Cha et al. (2014) noted that self-efficacy was a significant predictor of food label use when purchasing food. In the same study, regular food label use also predicted dietary quality. In a different study, self-efficacy was a mediator between the perceived food environment and fruit/vegetable consumption (Gase, Glenn, & Kuo, 2015). Those who had higher self-efficacy in this study were more likely to purchase and consume fruits and vegetables more regularly that those with lower self-efficacy.

Researchers also observed that self-efficacy had an effect on healthy food consumption. In one study, researchers found that self-efficacy for both unhealthy food avoidance and healthy food consumption influenced eating decisions (Fitzgerald, Heary, Kelly, Nixon, & Shevlin, 2013). In another study, those with higher self-efficacy used healthier cooking methods and obtained unhealthy foods less often (Mead, Gittelsohn, Roache, & Sharma, 2010). Guntzviller, King, Jensen, and Davis (2016) reported that the interaction between health literacy and self-efficacy was significant and positively associated with fruit/vegetable consumption. In this study, those with higher health literacy levels had higher nutrition self-efficacy. As a participant's nutrition self-efficacy increased, he/she was more likely to consume more fruits/vegetables daily.

A correlation between nutrition self-efficacy and healthy eating was observed among Australian individuals. Smith, McNaughton, Cleland, Crawford, and Ball (2013) studied the correlates of breakfast skipping among 4123 Australian women of lower socioeconomic status. The researchers reported that those with lower nutrition self-

efficacy ate breakfast two times or less per week. Williams, Thornton, and Crawford (2012) studied the factors promoting healthy eating and reducing the occurrence of unhealthy eating behavior among 1013 Australian women. Using data collected via a cross-sectional self-report study, the researchers determined that nutrition self-efficacy was among the major factors contributing to healthy eating behavior.

Lastly, participants with higher self-efficacy in Anderson, Winett, and Wojcik's (2007) study had lower levels of fat and higher levels of fiber, fruits, and vegetables in their diets compared to participants with lower self-efficacy. In this study, data were collected from 712 participants on nutrition related self-efficacy and other factors. The researchers reported that nutrition self-efficacy was among the important contributors to nutrition behavior, and that improving nutrition self-efficacy should help adults perform healthy eating behaviors more regularly.

Effects of Health Literacy on Nutrition Self-Efficacy

Researchers have observed a positive association between health literacy and nutrition self-efficacy. Cha et al. (2014) defined health literacy as an individual's capability to obtain, understand, and use health information to make an appropriate health-related decision. In one study, researchers found that as health literacy increased, the positive relationship between healthy eating and self-efficacy became stronger (Guntzviller, King, Jensen, & Davis, 2016). In the same study, the interaction between health literacy and nutrition self-efficacy was significant and positively associated with fruit/vegetable consumption. The researchers noted correlation between health literacy and nutrition self-efficacy, specifically in a Hispanic population.

Results reported by Smith-Miller, Berry, DeWalt, and Miller (2015) support these findings. The researchers collected information about knowledge, self-efficacy, and healthy lifestyle behaviors from 30 participants. The researchers administered questionnaires orally in Spanish to the 30 participants. The researchers reported that Spanish-speaking Hispanic immigrants with higher health literacy were more likely to use healthy eating as a self-management technique for type 2 diabetes than Spanish-speaking Hispanic immigrants with lower health literacy.

Effects of Food Security on Nutrition Self-Efficacy

Researchers have observed a positive association between food security and nutrition self-efficacy. In one study, perceived access to healthy foods and household food inventory both had a positive effect on self-efficacy (Kegler, Swan, Alcantara, Feldman, & Glanz, 2014). In another study, perception of ease of access to fruits/vegetables was associated with nutrition self-efficacy (Gase, Glenn, & Kuo, 2015). In this study, participants who reported that fruits and vegetables were more accessible were more confident in their ability to eat fruits and vegetables regularly.

Effects of Socioeconomic Status on Healthy Eating and Self-Efficacy

Socioeconomic status has also been positively associated with healthy eating and nutrition self-efficacy. Mead, Gittelsohn, Roache, and Sharma (2010) studied the effects of intentions for healthy eating and socioeconomic status on healthy eating behavior. The researchers reported that individuals of higher socioeconomic status had a greater nutrition self-efficacy than those of lower socioeconomic status in their study. Anderson, Winett, and Wojcik (2009) also studied the effects of socioeconomic status on healthy

eating behavior. The researchers reported that in their study, individuals with higher socioeconomic status had healthier fiber and fruit/vegetable consumption levels compared to those of lower socioeconomic status.

Literature Review Discussion

The associations between healthy eating, nutrition self-efficacy, and socioeconomic status are interrelated. Researchers reported that nutrition self-efficacy was associated with three facets of socioeconomic status: health literacy, food security, and overall socioeconomic status. Researchers also reported that increased nutrition self-efficacy had a positive effect on healthy eating behavior. More research is needed to better understand this association, because it may aid public health professionals in creating and implementing healthy eating interventions.

Increased nutrition self-efficacy has a positive effect on healthy eating. Self-efficacy influenced both healthy food acquisition and healthy food consumption in multiple studies. These findings may be used to advocate the significance of self-efficacy when acquiring food items and preparing meals. Although research on the association between healthy eating and self-efficacy was consistent across all studies, more research is needed to examine this relationship across multiple study populations and settings.

Other variables reported to influence nutrition behavior and nutrition self-efficacy included social support and perceived barriers. Researchers observed that family support (Kegler, Swan, Slcantara, Feldmen, & Glanz, 2014) and peer support (Fitzgerald, Heary, Kelly, Nixon, & Shelvin, 2013) for healthy eating improved nutrition self-efficacy. Researchers also reported that perceived barriers to healthy eating, specifically time necessary to prepare healthy meals and the cost of healthy eating, decreased healthy

eating (Williams, Thornton, and Crawford, 2012) and nutrition self-efficacy (Bruening, Kubik, Kenyon, Davey, & Story, 2010). Understanding and subsequently removing barriers to healthy eating may improve dietary habits and decrease obesity rates in the United States.

Literature Review Conclusions

Currently, the association between socioeconomic status and nutrition self-efficacy is understudied and not well understood. Future research should aim to continue to study this association. Researchers should also expand findings by studying other aspects of socioeconomic status. Researchers should study different aspects of socioeconomic status to develop a better understanding of this association. Once the association between socioeconomic status and nutrition self-efficacy has been studied thoroughly, public health professionals can create interventions to improve nutrition self-efficacy by removing socioeconomic barriers to healthy eating. Once these barriers have been eliminated, nutrition behaviors may improve nationwide, which will decrease obesity and its comorbidities in the United States.

CHAPTER THREE

Methods

Word Hunger Relief, Inc. and the Veggie Van

World Hunger Relief, Inc. (WHRI) is a Christian organization based in Elm Mott,

Texas that is committed to the alleviation of hunger around the world (*Who We Are*, n.d.).

Employees of WHRI train, educate, and participate in sustainable development programs

to alleviate worldwide hunger. WHRI was developed in 1976 by Bob and Jan Salley.

Since its conception, employees of WHRI have trained over 350 interns to address

hunger needs throughout the world (*Who We Are*, n.d.).

The Veggie Van is a program that was implemented in the spring of 2015 by

WHRI (*Veggie Van,* n.d.). The Veggie Van is a mobile produce market from which

WHRI employees and volunteers sell fresh fruits and vegetables in McLennan County

"food deserts," or locations where there is not a grocery store within a walkable distance.

WHRI employees operate The Veggie Van multiple days per week and stops at several

locations around McLennan County

Participants

Veggie Van customers throughout McLennan County were invited to participate

in a survey. Eligible participants were English-speaking adults aged 18 years or older

who provided verbal informed consent to participate in the survey.

Procedure

Twelve graduate students and twenty-five undergraduate students were trained to administer the cross-sectional Veggie Van Questionnaire. In addition to specific Veggie Van Questionnaire training, data collectors were required to complete the Collaborative Institutional Training Initiative (CITI) training to participate in data collection.

Data collectors began by explaining the research procedure to participants, including the inclusion criteria, anonymity, risk and benefits, and total time commitment of 10 minutes. After explaining the research project to participants, data collectors asked participants "would you like to participate?" and received verbal informed consent from each participant.

After receiving informed consent from each participant, data collectors verbally administered the Veggie Van Questionnaire. Data collectors read each item along with its corresponding response choices to each participant. Once a participant had completed the Veggie Van Questionnaire, he/she received a $5 "Veggie Bucks" voucher to be used at the Veggie Van for the future purchase of fruits and vegetables. After receiving gift vouchers, participants acknowledged that they had received the incentive by signing a gift voucher log. This signature was not linked to the participants' surveys.

Data were collected each Tuesday, Wednesday, and Thursday from January 14 to May 5, which yielded 128 surveys. Data were collected each Monday, Wednesday, and Thursday from September 7 to December 4, which yielded 64 surveys. Overall, 272 Veggie Van customers were asked to participate in the survey, and 192 individuals to participate, yielding a response rate of 70.5%.

Questionnaire

Section One of the Veggie Van Questionnaire contained questions concerning the participant's demographics and previous health history. This section contained questions concerning participants' ages, genders, races/ethnicities, perceived health statuses, heights and weights. This section also contained questions concerning participants' education levels. Data about previous health history, including diagnoses of hypertension, diabetes, overweight/obese, high blood cholesterol, and other heart disease, were also collected.

Nutrition self-efficacy was measured in Section Four of the questionnaire. Self-efficacy was measured using the "Fruits & Vegetables Confidence" section of the PACE Adult Diet and Physical Activity Measures developed by Dr. James F. Sallis, Ph.D. et al (Sallis, Pinski, Grossman, Patterson, Nader, 1988). The PACE Adult Diet and Physical Activity Measures are based on the social cognitive theory and the transtheoretical model (Sallis et al., 1988). Questions from the PACE Adult Diet and Physical Activity Measures used in this section of the Veggie Van Questionnaire included: "How confident are you that you can eat five servings of fruits and vegetables every day," "how confident are you that you can drink 100% fruit juice instead of soda or fruit punch," "how confident are you that you can eat fruits and vegetables for a snack instead of chips and candy," "how confident are you that you can eat fruits and vegetables when eating out at a restaurant," "how confident are you that you can eat fruits and vegetables when you are upset or having a bad day," and "how confident are you that you can eat fruits and vegetables when you are at a social event?" Answer choices for these questions included: extremely

confident, very confident, moderately confident, somewhat confident, or not at all confident.

Normal et al. (2010) tested the reliability and validity of the psychosocial measures related to dietary behaviors included the PACE Adult Diet and Physical Activity Measures. The test-restest reliability of all psychosocial measures was assessed among a sample of 49 college students. The researchers reported an intraclass correlation coefficient of 0.70 for the fruit and vegetable self-efficacy portion of the psychosocial measures, which was used in the Veggie Van Questionnaire. The convergent and discriminant validity of all psychosocial measures were also assessed. The researchers reported that the fruit and vegetable self-efficacy portion of the psychosocial measures demonstrated adequate correlations with corresponding dietary nutrient estimates.

A visual aid was available to help participants answer the nutrition self-efficacy questions. The visual aid was used to help those with lower literacy levels distinguish between answer choices. The visual aid included a color gradient ranging from the color green ("Extremely Confident") to the color red ("Not at all Confident").
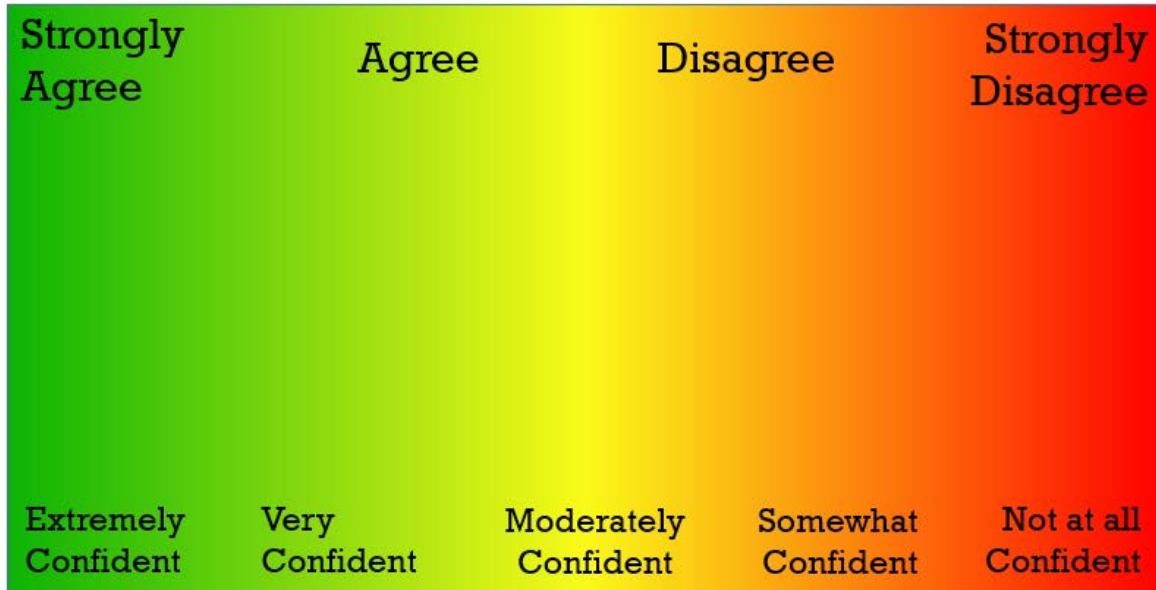
Figure 2. Visual aid used for nutrition self-efficacy questions

Data Analysis

Descriptive statistics for demographic and socioeconomic variables were

calculated. Means and standard deviations were reported for participant age and average

nutrition self-efficacy score. Percentages were reported for race/ethnicity, education

level, benefit eligibility (SNAP, WIC, and free/reduced lunch), and for category

responses to self-efficacy questions. Socioeconomic status was conceptualized as benefit

eligibility and educational attainment. Benefit eligibility and education levels were

determined by participants' responses on the questionnaire. Benefit eligibility was

categorized as "Eligible for benefits" and "Not eligible for benefits." Education level was

categorized as "High school diploma/GED or less" and "Greater than high school

diploma." High school diploma/GED was used as the cutoff point for dichotomization

because this is a standard cut point in health research.

Six questions were to assess nutrition self-efficacy. These questions were selected

from the PACE Adult Diet and Physical Activity Measures, and were scored according to

recommendations by the authors (Sallis et al., 1988). Participants answered each question with one of five responses, and each response converted to a numerical value: (1) extremely confident,(2) very confident, (3) moderately confident, (4) somewhat confident, and (5) not at all confident. The mean of each question was calculated for the entire sample, and then stratified by benefit eligibility and education level. Within individuals, mean response values were used for an overall nutrition self-efficacy score. The mean of overall nutrition self-efficacy scores was calculated for the entire sample, and then stratified by benefit eligibility and education level.

Student t-tests were used to evaluate the bivariate relationship between item-specific and overall nutrition self-efficacy and benefit eligibility and between item-specific and overall nutrition self-efficacy and educational attainment. Finally, generalized linear models were used to assess the relationship between overall nutrition self-efficacy and socioeconomic variables, adjusting for age, sex, and race/ethnicity. Analyses were conducted using Microsoft Excel and SAS v9.4 (SAS Institute Inc., Cary, NC, USA) and statistical significance was defined at the two-sided $\alpha=0.05$ level.

CHAPTER FOUR

Final Manuscript

Abstract

Obesity is a growing public health issue nationally and worldwide. Eating behavior may be a modifiable risk factor for obesity. Low nutrition self-efficacy and lack of access to healthy foods may inhibit healthy eating. Implementation of mobile produce markets may be effective in improving access to healthy foods, but little is known about mobile market users. Mobile produce market users of the Veggie Van in McLennan County, TX (n=192) were asked about government benefit eligibility, education levels, and nutrition self-efficacy. Nutrition self-efficacy of mobile produce market users was moderately high. In this study, race/ethnic minority market users and had lower overall nutrition self-efficacy, after adjusting for age, sex, and socioeconomic status. Overall, mobile produce markets may be effective in improving access to healthy foods nationally. Use of mobile produce markets could improve eating behaviors and decrease obesity rates in the United States.

Introduction

Obesity is a growing public health issue both in the United States and worldwide. Worldwide, over 600 million people were obese in 2014, and the rate of obesity has almost doubled since 1980. Nationally, the Centers for Disease Control and Prevention (CDC, 2015) estimates that 34.9% of Americans are obese. Increases in obesity have both medical and financial consequences. Obesity is associated with many different chronic

diseases, including cardiovascular disease, stroke, type 2 diabetes, and certain kinds of cancer (CDC, 2015). Worldwide, 23% of ischemic heart disease, between 7% and 41% of cancer burdens, and 44% of type 2 diabetes are related to overweight/obesity (WHO, 2015). These chronic diseases are also some of the leading causes of preventable death in the United States (CDC, 2015). Obesity and its associated medical conditions have a high financial burden. In 2014, the individual cost of obesity was $1,901 annually, which accounted for $149.9 billion at the national level.

Unhealthy eating behavior may be a modifiable risk factor for obesity. According to the United States Department of Agriculture's (USDA) dietary guidelines, a healthy diet includes whole grains, fat-free/low-fat dairy, a variety of protein sources (including animal sources like lean meats and seafood, soy products, legumes, nuts and seeds), a variety of fruits and vegetables, and oils from plants, while limiting trans fats, sodium, and added sugars.

Although fruit and vegetable consumption may improve health, many barriers can inhibit an individual's ability to consume a healthy diet. In 1977, Urie Bronfenbrenner first described the Ecological Framework for Human Development, known today as the Social Ecological Model (Bronfenbrenner, 1977). Bronfenbrenner described five hierarchical levels that may influence an individual's behavior: individual, microsystem (interpersonal), mesosystem (community), exosystem (organizational), and macrosystem (policy). According to Bronfenbrenner, factors affecting healthy behaviors can occur at any of these five levels.
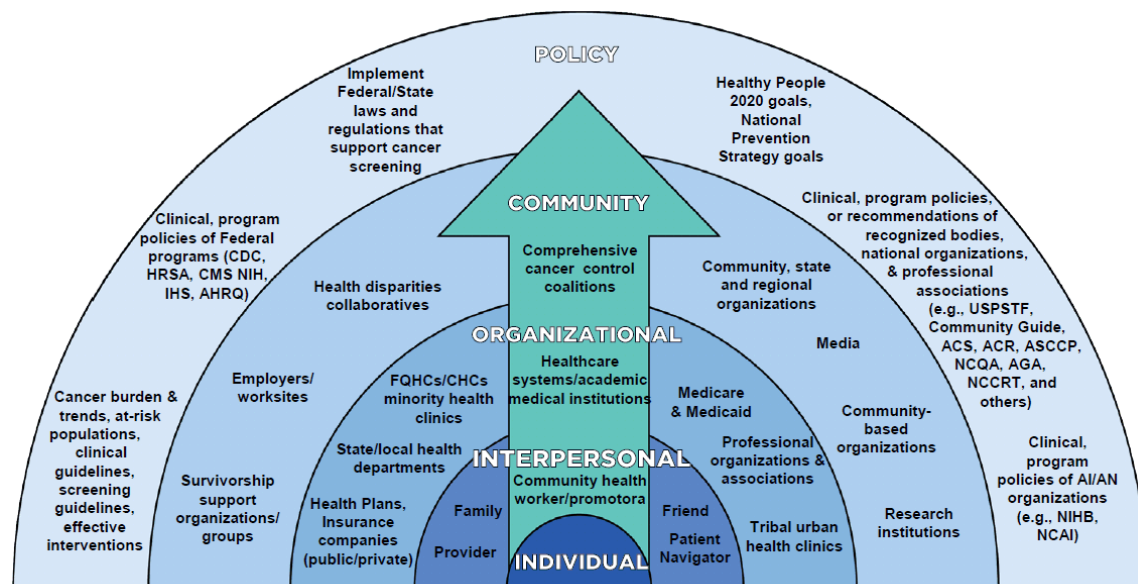
Figure 1. The Social Ecological Model (CDC, 2013)

An individual's physical environment may promote or impede his or her healthy eating behaviors at the organizational and community levels. Limited physical access to healthy foods, such as a food desert, or limited financial access to healthy foods, such as high prices of fresh fruits and vegetables, may impede an individual's ability to consume a healthy diet. (Dijkstra et al., 2015). A food desert is defined as a low-income census tract wherein at least 33% of the population lives more than 1 mile from the nearest grocery store in an urban area or 10 miles from a grocery store in a rural area (Tolzman, Rooney, Duquette, and Rees, 2014). Individuals who live in food deserts typically have reduced access to healthy foods due to lack of grocery stores, limited transportation to travel to the nearest store, and high prices of fruits and vegetables at local corner stores, all of which can limit healthy diet choices.

One potential strategy to increase or improve access to healthy foods is a mobile produce market. A mobile produce market is a mobile vendor where fresh fruits and vegetables are sold. Typically, mobile produce markets operate in areas that are

considered food deserts. Examples of mobile produce markets around the United States include: Freshest Cargo (California), Red Stick Mobile Farmer's market (Louisiana), Arcadia Mobile Market (Washington, DC) and Go Fresh Mobile Market (Massachusetts). The Veggie Van is a mobile produce market in McLennan County that is used to alleviate food deserts and hunger by improving access to healthy foods among central Texas residents.

Although the Veggie Van was designed to eliminate environmental barriers to healthy eating like access to food, individual characteristics such as nutrition self-efficacy may affect the use of the Van program. Self-efficacy is defined as one's belief in his or her ability to succeed in specific situations or to accomplish specific tasks (Bandura, 1977). Individuals with higher self-efficacy are more likely to make necessary efforts to achieve a desirable outcome, regardless of opposing factors or barriers (Cha et al., 2014). More specifically, nutrition self-efficacy is an individual's confidence in his or her ability to perform nutrition-related behaviors, like incorporate fruits and vegetables into one's diet.

Purpose and Significance

Nutrition self-efficacy is one individual factor that may influence nutrition-related behaviors. Understanding nutrition self-efficacy of mobile market customers may help researchers design nutrition-related interventions to improve Veggie Van usage. These interventions, if expanded to other areas of the country, could potentially increase nutrition self-efficacy and the proportion of Americans that meet the USDA guidelines for fruit and vegetable consumption, therefore mitigating rising obesity rates in the United States (Gase, Glenn, & Kuo, 2015; Guntzviller, King, Jensen, & Davis, 2016).

Thus, the purpose of this study was to examine the association between nutrition self-efficacy and socioeconomic status among Veggie Van users.

Methods

Participants

Veggie Van customers in McLennan County were invited to participate in a brief survey. Eligible participants were English-speaking adults aged 18 years or older who provided verbal informed consent to participate in the survey.

Procedure

Twelve graduate students and twenty-five undergraduate students were trained to administer the Veggie Van Questionnaire. In addition to specific Veggie Van Questionnaire training, data collectors were required to complete the Collaborative Institutional Training Initiative (CITI) training to participate in data collection. This survey project was determined exempt by the Baylor University Institutional Review Board.

Data collectors began by explaining the research procedure to participants, including the inclusion criteria, anonymity, risk and benefits, and total time commitment of 10 minutes. After explaining the research project to participants, data collectors asked participants "would you like to participate?" and received verbal informed consent from each participant.

After receiving informed consent from each participant, data collectors verbally administered the Veggie Van Questionnaire. Data collectors read each item along with its corresponding response choices to each participant. Once a participant had completed the

Veggie Van Questionnaire, he/she received a $5 "Veggie Bucks" voucher to be used at the Veggie Van for the future purchase of fruits and vegetables. After receiving vouchers, participants acknowledged that they had received the incentive by signing a gift voucher log. This signature was not linked to the participants' surveys.

Data were collected each Tuesday, Wednesday, and Thursday from January 14 to May 5, which yielded 128 surveys. Data were collected each Monday, Wednesday, and Thursday from September 7 to December 4, which yielded 64 surveys. Overall, 272 Veggie Van customers were asked to participate in the survey, and 192 individuals completed the survey, yielding a response rate of 70.5%.

Questionnaire

First, participants were asked for sociodemographic information, including age, sex, race/ethnicity, and high level of education completed, perceived health status, height, and weight. Participants were also asked about the use of SNAP, WIC, and free/reduced school lunch benefits to the household. Education level and government benefit eligibility were used as socioeconomic variables for this study.

Self-efficacy was measured is Section Four of the Veggie Van Questionnaire, using the "Fruits & Vegetables Confidence" section of the PACE Adult Diet and Physical Activity Measures developed by Dr. James F. Sallis, Ph.D. et al (Sallis, Pinski, Grossman, Patterson, Nader, 1988). The PACE Adult Diet and Physical Activity Measures are based on the social cognitive theory and the transtheoretical model (Sallis et al., 1988). Normal et al. (2010) tested the reliability and validity of the psychosocial measures related to dietary behaviors included the PACE Adult Diet and Physical Activity Measures. A small test-retest reliability study of college students found that an

intraclass correlation coefficient of 0.70 for the fruit and vegetable self-efficacy portion of the psychosocial measures (Norman et al., 2010). The researchers also determined the convergent and discriminant validity of all psychosocial measures with the fruit and vegetable self-efficacy portion demonstrated adequate correlations with corresponding dietary nutrient estimates.

Data Analysis

Descriptive statistics for demographic and socioeconomic variables were calculated. Means and standard deviations were reported for participant age and average nutrition self-efficacy score. Percentages were reported for race/ethnicity, education level, benefit eligibility (SNAP, WIC, and free/reduced lunch), and for category responses to self-efficacy questions. Socioeconomic status was conceptualized as benefit eligibility and educational attainment. Dichotomized benefit eligibility and education levels were determined by participants' responses on the questionnaire. Benefit eligibility was categorized as "Eligible for benefits" and "Not eligible for benefits." Education levels were categorized as "High school diploma/GED or less" and "Greater than high school diploma." High school diploma/GED was used as the cutoff point for dichotomization because approximately one-third of the sample had a high school diploma/GED or less, and this is a standard cut point in health research.

Six questions were used to assess nutrition self-efficacy, defined as confidence in eating five servings of fruits and vegetables daily, drinking fruit juice instead of other sugary beverages, and eating fruits and vegetables as a snack, when eating out, when upset or having a bad day, and when at a social event. These questions were derived from the PACE Adult Diet and Physical Activity Measures, and were scored according to

recommendations by the authors (Sallis et al., 1988). Participants could answer each question with one of five responses, and each response was given a correlating numerical value: extremely confident (1), very confident (2), moderately confident (3), somewhat confident (4), and not at all confident (5). The mean of each question was calculated for the entire sample, and the stratified by benefit eligibility and education level. Within individuals, mean response values were used for an overall nutrition self-efficacy score. The mean of overall nutrition self-efficacy scores was also calculated for the entire sample, and then stratified by benefit eligibility and education level.

Student t-tests were used to evaluate the bivariate relationship between item-specific and overall nutrition self-efficacy and benefit eligibility and between item-specific and overall nutrition self-efficacy and educational attainment. Finally, generalized linear models were used to assess the relationship between overall nutrition self-efficacy and socioeconomic variables, adjusting for age, sex, and race/ethnicity. Analyses were conducted using Microsoft Excel and SAS v9.4 (SAS Institute Inc., Cary, NC, USA) and statistical significance was defined at the two-sided $\alpha=0.05$ level.

Results

Sample Characteristics

One hundred ninety-two customers participated in the Veggie Van questionnaire. The average age of the individuals in the sample was 47.1 years of age. Approximately three-fourths of the sample were female. Over half of the sample identified as non-Hispanic white, and approximately one-quarter identified as non-Hispanic black. Approximately one-third of the sample had a high school diploma or GED equivalent,

approximately one-third had completed some college courses but no college degree, and approximately one-third had received at least Bachelor's degree. Participants were also asked if they were eligible for SNAP, WIC, or free/reduced lunch. Approximately one-third of the sample was eligible for SNAP, approximately one-tenth was eligible for WIC, and approximately one-fifth was eligible for free/reduced lunch. In total, 37.5% of participants were eligible for at least one of these benefits. Characteristics of the study sample are summarized in Table 2.

Table 2

Characteristics of the total study population, Veggie Van Questionnaire 2016, n=192

Age (years(std))		47.1 (17.6)
Gender (%)		
	Male	24.0
	Female	76.0
Race/Ethnicity (%)		
	Non-Hispanic White	53.9
	Non-Hispanic Black	23.6
	Hispanic	16.8
	Other	5.7
Education Level (%)		
	High School Diploma/GED or less	31.8
	Some college	33.9
	College degree	17.2
	Some graduate school/Graduate degree	17.2
SNAP Eligibility (%)		
	Not Eligible	69.7
	Eligible	30.3
WIC Eligiblilty (%)		
	Not Eligible	89.9
	Eligible	10.1
Free/Reduced Lunch Eligibility (%)		
	Not Eligible	80.4
	Eligible	19.6

Nutrition Self-Efficacy

The first nutrition self-efficacy question asked to participants was "how confident are you that you can eat five servings of fruits and vegetables every day?" Most participants (32.3%) responded that they were very confident in their ability to eat five servings of fruits and vegetables every day. The sample average for this question was 2.6.

The second nutrition self-efficacy question asked to participants was "how confident are you that you can drink 100% fruit juice instead of soda or fruit punch?" Most participants (40.0%) responded that they were extremely confident in their ability to drink 100% fruit juice instead of soda or fruit punch. The sample average for this question was 2.2.

The third nutrition self-efficacy question asked to participants was "how confident are you that you can eat fruits and vegetables for a snack instead of chips and candy?" Most participants (45.8%) responded that they were very confident in their ability to eat fruits and vegetables for a snack instead of chips and candy. Possible scores ranged from 1 (not at all confident) to 5 (extremely confident). The sample average for this question was 2.1.

The fourth nutrition self-efficacy question asked to participants was "how confident are you that you can eat fruits and vegetables when eating out at a restaurant?" Most participants (44.2%) responded that they were very confident in their ability to eat fruits and vegetables when eating out at a restaurant. Possible scores ranged from 1 (not at all confident) to 5 (extremely confident). The sample average for this question was 2.4.

The fifth nutrition self-efficacy question asked to participants was "how confident are you that you can eat fruits and vegetables when you are upset or having a

bad day?" Most participants (37.0%) responded that they were very confident in their ability to eat fruits and vegetables when upset or having a bad day. Possible scores ranged from 1 (not at all confident) to 5 (extremely confident.) The sample average for this question was 2.8.

The final nutrition self-efficacy question asked to participants was "how confident are you that you can eat fruits and vegetables when you are at a social event?" Most participants (40.6%) responded that they were very confident in their ability to eat fruits and vegetables when at a social event. Possible scores ranged from 1 (not at all confident) to 5 (extremely confident). The sample average for this question was 2.5.

A summary score was also calculated to determine participants' average self-efficacy. The average nutrition self-efficacy score for the total population was 2.4, meaning that participants were moderately-to-very confident in their abilities to eat fruits and vegetables in situations described in the fruit and vegetable self-efficacy portion of the PACE survey. Responses to individual nutrition self-efficacy questions are presented in Table 3, and mean values are presented in Table 4 and Table 5.

Nutrition Self-Efficacy by Government Benefit Eligibility

After nutrition self-efficacy was assessed for the total sample, the sample was stratified into two groups: "eligible for benefits" and "not eligible for benefits." Those who were eligible for SNAP, WIC, or free/reduced lunch were classified as "eligible for benefits" (n=72) and those were not eligible for SNAP, WIC, or free/reduced lunch were classified as "not eligible for benefits" (n=120). The mean score for responses to each of the six self-efficacy question and an average nutrition self-efficacy score were calculated for each group. A summary of this analysis is shown in Table 4. There were no

Table 3

Nutrition self-efficacy, Veggie Van Questionnaire 2016, n=192.

Confidence in eating 5 servings of fruits and vegetables (F/V)
everyday (%)

	Extremely	19.3
	Very	29.2
	Moderately	32.3
	Somewhat	8.9
	Not at all	10.4

Confidence in drinking 100% fruit juice instead of soda or
fruit punch (%)

	Extremely	40.0
	Very	30.5
	Moderately	10.0
	Somewhat	10.5
	Not at all	8.9

Confidence in eating F/V for a snack instead of chips/candy
(%)

	Extremely	27.1
	Very	45.8
	Moderately	20.3
	Somewhat	4.7
	Not at all	2.1

Confidence in eating F/V when eating out at a restaurant (%)

	Extremely	19.5
	Very	44.2
	Moderately	17.9
	Somewhat	12.6
	Not at all	5.8

Confidence in eating F/V when upset or having a bad day (%)

	Extremely	14.6
	Very	37.0
	Moderately	18.8
	Somewhat	16.7
	Not at all	13.0

Confidence in eating F/V when at a social event (%)

	Extremely	15.6
	Very	40.6
	Moderately	24.5
	Somewhat	15.6
	Not at all	3.6

Table 4

Nutrition self-efficacy item average (mean(standard deviation)), for total study population and by benefit eligibility, Veggie Van Questionnaire, 2016.

Nutrition Self-Efficacy Area Studied	Total (n=192)	Eligible for Benefits (n=72)	Not Eligible for Benefits (n=120)	*p*
Confidence in eating 5 servings of fruits and vegetables (F/V) everyday	3.4 (1.2)	3.3 (1.2)	3.4 (1.2)	0.68
Confidence in drinking 100% fruit juice instead of soda or fruit punch	3.8 (1.3)	3.8 (1.3)	3.8 (1.3)	0.90
Confidence in eating F/V for a snack instead of chips or candy	3.9 (0.9)	4.0 (1.0)	3.9 (0.9)	0.48
Confidence in eating F/V when out at a restaurant	3.6 (1.1)	3.7 (1.2)	3.5 (1.1)	0.34
Confidence in eating F/V when upset or having a bad day	3.2 (1.3)	3.1 (1.3)	3.3 (1.2)	0.30
Confidence in eating F/V when at a social event	3.5 (1.1)	3.6 (1.0)	3.4 (1.1)	0.42
Average nutrition self-efficacy score	3.6 (0.7)	3.6 (0.7)	3.6 (0.7)	0.92

statistically significant differences in individual nutrition self-efficacy items or in the overall nutrition self-efficacy score by benefit status.

Nutrition Self-Efficacy by Education Level

After nutrition self-efficacy was assessed for the total sample, the total sample was stratified into two groups again: "HS/GED or less" and "More than HS." Those whose highest level of education was receiving a high school diploma or equivalent were classified as "HS/GED or less" (n=61). Those who had at least attended some college classes were classified as "More than HS" (n=131). The mean score for responses to each of the six self-efficacy question and an average nutrition self-efficacy score were calculated for each group. A summary of this analysis is shown in Table 5. There were no statistically significant differences in individual nutrition self-efficacy items or in the overall nutrition self-efficacy score by educational attainment status.

Multivariate Generalized Linear Models

Multivariate generalized linear models were used to determine the relationship between overall nutrition self-efficacy and benefit eligibility and education level, controlling for age, sex, and race/ethnicity. We observed a positive relationship between overall nutrition self-efficacy and age, sex (female vs. male), benefit eligibility (eligible vs. not eligible), and education level (high school diploma/GED or less vs. more than high school), but these relationships were not statistically significant at the $\alpha=0.05$ level. We observed a statistically significant inverse relationship between non-Hispanic black and Hispanic race/ethnicity and overall nutrition

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Table 5

Nutrition self-efficacy item average (mean (standard deviation)), for total study population and by education level, Veggie Van Questionnaire, 2016.

Nutrition Self-Efficacy Area Studied	Total (n=192)	HS/GED or less (n=61)	More than HS (n=131)	p
Confidence in eating 5 servings of fruits and vegetables (F/V) everyday	3.4 (1.2)	3.4 (1.2)	3.4 (1.2)	0.72
Confidence in drinking 100% fruit juice instead of soda or fruit punch	3.8 (1.3)	3.7 (1.3)	3.9 (1.3)	0.55
Confidence in eating F/V for a snack instead of chips or candy	3.9 (0.9)	3.9 (1.0)	3.9 (0.9)	0.55
Confidence in eating F/V when out at a restaurant	3.6 (1.1)	3.8 (1.0)	3.5 (1.2)	0.09
Confidence in eating F/V when upset or having a bad day	3.2 (1.3)	3.0 (1.4)	3.3 (1.2)	0.10
Confidence in eating F/V when at a social event	3.5 (1.0)	3.5 (1.1)	3.5 (1.0)	0.87
Average nutrition self-efficacy	3.6 (0.7)	3.5 (0.8)	3.6 (0.6)	0.87

self-efficacy, even after adjusting for age, sex, and socioeconomic status, indicating that these race/ethnic minority groups have lower nutrition self-efficacy than their non-Hispanic white counterparts. The multivariate generalized linear models are shown in Table 6.

Discussion

Overall, Veggie Van users were moderately-to-very confident in their abilities to perform specific healthy eating behaviors, as measured by the fruit and vegetable self-efficacy portion of the PACE survey. For all but one of the self-efficacy questions, the majority of participants responded that they were at least "very confident" that they could perform specific healthy eating behaviors. Food security has been positively associated with nutrition self-efficacy (Kegler, Swan, Alcantara, Feldman, & Glanz, 2014). Perception of ease of access to fruits and vegetables has also been positively associated with nutrition self-efficacy (Gase, Glenn, & Kuo, 2015). The Veggie Van is used to increase food security and eliminate food deserts across McLennan County, thus Veggie Van users may have higher nutrition self-efficacies because they perceive that they are more food secure, even though they are visiting a mobile produce market in a food desert. We hypothesized that those who were eligible for benefits would have a lower nutrition self-efficacy that those who were not eligible for benefits. We also hypothesized that those whose highest level of education was a high school diploma/GED would have a lower nutrition self-efficacy than those who had at least attended some college. Our hypotheses were not supported by our findings because we observed not relationship between nutrition self-efficacy and benefit eligibility or education level. Average nutrition self-efficacy scores were similar between education levels and benefit

Table 6

Multivariate generalized linear models (β (standard error)) for average nutrition self-efficacy, Veggie Van Questionnaire, 2016, n=192.

Variable	Benefit Eligibility		Education Level	
	β (SE)	*p*	β (SE)	*p*
Intercept	3.65 (0.18)	<0.001	3.66 (0.18)	<0.001
Age, years	0.00 (0.00)	0.18	0.00 (0.00)	0.18
Sex (Female vs. Male)	-0.02 (0.12)	0.88	-0.02 (0.12)	0.88
Non-Hispanic Black	0.26 (0.13)	0.04	0.26 (0.13)	0.04
Hispanic	0.33 (0.15)	0.03	0.34 (0.15)	0.02
Other	0.07 (0.22)	0.74	0.07 (0.22)	0.73
Benefits (Yes vs. No)	-0.03 (0.11)	0.80		
Education (HS/GED or less vs. More than HS)			0.061 (0.11)	0.45

eligibility. Health literacy, which could be influenced by education level, has been positively associated with nutrition self-efficacy (Guntzviller, King, Jensen, & Davis, 2016; Smith-Miller, Berry, DeWalt, & Miller, 2015). In other studies, overall socioeconomic status has been positively associated with nutrition self-efficacy (Mead, Gittelsohn, Roache, & Sharma, 2010), indicating that our results are inconsistent with studies outside of mobile market customers.

We observed a statistically significant association between average nutrition self-efficacy and race/ethnic minority groups. Those who identified as non-Hispanic black and Hispanic were more likely to have lower average nutrition self-efficacy scores than those who identified as non-Hispanic white. Although race/ethnicity was not one of our main variables of interest, these findings could be a starting point for future research.

One potential reason that we did not observe a relationship between nutrition self-efficacy and the socioeconomic variables is that our sample may not have been an accurate representation of all Veggie Van users. Our sample was predominately non-Hispanic white, highly educated, and around 20% were eligible for benefits. From 2009-2013 the U.S. Census Bureau (2015) conducted a 5-year American Community Survey in the four zip codes where the Veggie Van sells fresh fruits and Vegetables. According to the Census Bureau, 42.7% identified as Non-Hispanic White and 21.2% identified as Non-Hispanic Black. The largest difference in race/ethnicity between our sample and the population of this area is the percentage of individuals who identified as Hispanic. Over 30% of individuals in this area identify as Hispanic, but only 16.8% of our sample identified as Hispanic. 26.9% of individuals in this area was eligible for SNAP, and over 30% of residents were eligible for SNAP in two of these four zip codes, which was

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slightly higher than our sample. These differences are described in Table 7. Individuals who declined participation in the survey may have identified as a race/ethnic minority, been Spanish-speaking, had lower education levels, and/or were eligible for benefits. These individuals may have also declined due to having lower nutrition self-efficacies.

Another potential reason that we did not observe a relationship between nutrition self-efficacy and the socioeconomic variables is that participants were required to be English speaking to participate. Those who were not English speakers may have had lower education levels and may have been eligible for SNAP, WIC, or free/reduced lunch. These individuals may have had lower nutrition self-efficacies because they would be unable to read nutrition facts and food labels that were in English.

Another potential limitation of this study is its cross-sectional design. We evaluated nutrition self-efficacy of participants only at the time of data collection. Thus, we were unable to assess the impact of the Veggie Van on the change in nutrition self-efficacy of Veggie Van users over time. Nevertheless, this is the first study to evaluate mobile produce market customers in terms of nutrition self-efficacy. Use of the cross-sectional design is beneficial for generating hypotheses for future programmatic and research work.

Conclusions

The goal of mobile produce markets is to increase fruit and vegetables consumption in the United States. Although fruit and vegetable consumption is a crucial part of maintaining a healthy diet, many individuals in the United States are not able to acquire fresh fruits and vegetables because they live in food deserts. Eliminating the

Table 7

Characteristics of the Veggie Van service area in Waco, TX

Location/Zip Code	Total Population	Race/Ethnicity				% of households with food stamps/SNAP
		Hispanic	NH White	NH Black	NH Other	
76704	8,097	1,231	526	6,069	271	41.9%
76706	36,055	10,886	19,256	4,283	1,630	15.9%
76707	15,501	7,759	3,535	3,815	392	32.5%
76708	26,028	8,034	13,325	3,973	696	17.4%
Total Veggie Van	**85,681 (100%)**	**27,910 (32.6%)**	**36,642 (42.7%)**	**18,140 (21.2%)**	**2,989 (3.5%)**	--

Source: U.S. Census Bureau, 2009-2013 5-Year American Community Survey

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environmental barrier of lack of access to healthy foods is essential to improving healthy eating behavior.

The Veggie Van was designed to eliminate lack of access to healthy foods and increase healthy eating behavior among McLennan County residents, and nutrition self-efficacy is high among members of this community. More research is needed to determine other potential factors associated with nutrition self-efficacy among Veggie Van users in order to develop interventions that can be used to improve nutrition self-efficacy and increase healthy eating in this community.

Nationally, little research has been conducted among mobile produce market users. It is important to evaluate the use of mobile produce markets to determine how they can be effectively used to increase nutrition self-efficacy of their users. Once the most effective method of mobile produce market management has been determined, owners of other markets can work to improve the effectiveness of their markets, and owners of new mobile produce markets will have a model for implementation. Increasing the quantity and quality of mobile produce markets nationally will aid in eliminating food deserts. As access to healthy foods increases at the national level, obesity rates across the United States may decrease.

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