A Text-based Intervention: The Impact of Food Insecurity on Dietary Habits, Stress Management, and Food Assistance Resources Among College Students

by

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A dissertation submitted to the Graduate Faculty of
Auburn University
in partial fulfillment of the
requirements for the Degree of
Doctor of Philosophy

Auburn, Alabama
August 4, 2018

Key words: text messaging, food secure, food insecure, college students, interviews, nutrition messages

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ABSTRACT

Food insecurity among college student is an issue that has received increased attention recently. The risk factors for food insecurity among college students include: age, race/ethnicity, living arrangement, work for pay, having children, financial independence and lack of food resource management skills. Food insecurity in college students is associated with lower grade point average (GPA), lower self-reported health, poor dietary habits (unbalanced meals, cutting size of meals, skipping meals and lower fruit and vegetable intake), inadequate sleep, and mental health issues (aggression, anxiety and depression). Implementing nutrition and health interventions among college students is necessary to mitigate the negative health outcomes associated with food insecurity.

A cross-sectional study to assess the prevalence and factors associated with food insecurity among college students was conducted. Additionally, in-depth interviews were conducted to explore the lived experiences of food insecure college students. These two studies were conducted as part of a needs assessment to develop an appropriate and directed nutrition and health intervention. Thirty-one percent of the surveyed students were food insecure, with 14% categorized as very low food security status. Students who reported living on-campus alone and smoking 6-11 cigarettes a day had higher odds of being food insecure. Food insecure students cope with food insecurity by skipping eating occurrences, cutting the portion sizes, or reducing the quality of their meals. Food insecurity impacts mental, physical, and social health of

the affected students. Additionally, food insecure students report that their concentration in class and grades are affected.

A 7-week text-based randomized control study was implemented to modify dietary habits (fruit and vegetable, sugar sweetened beverages intake, and mealtime behavior), stress management behaviors and create awareness of food assistance resources. The intervention group (n=22) received 3 intervention text messages per week for 7 weeks and the control group (n=24) received one email attachment containing the intervention messages at post-intervention. An online baseline and post-intervention survey to assess demographic characteristics (age, classification, gender and race/ethnicity – baseline only), anthropometric data (height and weight) fruit and vegetable intake, sugar sweetened beverage intake, food assistance resource awareness, Perceived stress, mealtime behavior, hours of sleep, and text message evaluation (post-intervention only) was administered. At baseline, the food secure students had more hours of sleep than the food insecure students (7.90 ± 1.29 vs 6.68 ± 1.22, respectively; $P < 0.05$). Repeated measures ANOVA with fixed effects of time and group demonstrated that perceived stress scores for the intervention and control groups reduced significantly at post-intervention. Text delivered intervention was acceptable and had promising outcomes among college students. Future studies should include visual aids and use repetitive text messages.

ACKNOWLEDGMENTS

I would like to thank Dr. Brown for her mentorship and support through the years, you patiently guided and molded me into the researcher I have become. I would also like to thank my dissertation committee members and university reader Drs. Duffy, Huggins, Jeganathan, and Worosz for your support throughout my dissertation process. I would also like to thank Dr. Thornton and her capstone class, it was wonderful working with you all. To my lab mates: Joel, Felicia and Aj, thanks for your friendship. To my family: Angela, Claire and Symon, thanks for your love, support and understanding.

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LIST OF ABBREVIATIONS

US	United Sates
USDA	United States Department of Agriculture
HFSSM	Household Food Security Survey Module
BMI	Body Mass Index
IRB	Institutional Review Board
SSB	Sugar Sweetened Beverage
SNAP	Supplemental Nutrition Assistance Program
WIC	Women Infants and Children

I: INTRODUCTION

Dissertation Organization

This dissertation is organized into seven chapters. Chapter 1 provides a synopsis of food insecurity within college students, purpose statement and research questions and objectives. Chapter 2 "*Food Insecurity among College Students in the United States: A Mini Review*" a manuscript published in the Journal of *Annals of Reviews and Research* (Mukigi D, Brown O, 2018) and comprehensive literature review of the research problems. Chapter 3 provides the study methodology. The 4th chapter is a manuscript prepared for submission to the *Journal of Open Medicine* (Mukigi D, Brown O, 2018). The 5th chapter "F*ood Insecurity Among College Students: An Exploratory Study"* is a manuscript published in the *Journal of Nutrition and Health Sciences* (Mukigi D, Thornton K, Binion A, et al, 2018). The 6th chapter is a manuscript prepared for the *Journal of American College Health* (Mukigi D, Brown O, 2018). Chapter 7 provides overall conclusions and recommendations for future research.

Research Problem

Food insecurity among college students is an emergent issue that has recently received increased attention. Results from several studies conducted in United States (US) college campuses indicate that food insecurity is an emerging issue among college students and the prevalence of food insecurity was found to be as high as 59.0% in one higher learning institution.[1–6] In response to this important student issue, an increasing number of colleges have established on-campus food pantries and currently there are 596 institutions registered by the

College and University Food Bank Alliance (CUFBA) .[7] CUFBA is a national organization that that provides training, resources and support for campus-based food pantries.[7] The increase in the number of institutions registered by CUFBA points to the increasing problem of food insecurity among college students. Reports by Feeding America, the largest emergency food assistance agency in the US indicate that 10% of their 46.5 million clients are students.[8] This indicates that food insecurity among college students is a growing problem and there is an urgent need for policy and mitigation measures to help affected students.

Available studies conducted on food insecurity among college students are primarily cross-sectional studies and use quantitative methods to describe the phenomenon.[1–3,6,9] These studies report prevalence and factors associated with food insecurity and therefore, there is limited understanding of the daily experiences and coping strategies used by food insecure college students. Consequently, this limits the development of practical interventions.[10] Thus, cause to conduct qualitative studies to gain more insight into the issue by adding the "voices" of the food insecure students.

Food insecurity is associated with adverse health outcomes across all age groups,[11] including obesity,[12,13] undernutrition,[14] inflammation,[15] aggression, anxiety and depression.[16] Among adolescents and children, food insecurity is associated with poor academic, behavioral and social outcomes including low math and reading scores,[11,17] poor psychosocial function,[18] absenteeism and suspension from school.[11,18] Among college students, food insecurity can affect academic and cognitive performance.[11] One study conducted among female African American students reported that food insecurity was a significant predictor of poor conflict resolution and low-self-esteem.[19]

An increase in enrollment of students from underrepresented groups like first-generation college attendees, students from low socioeconomic backgrounds, minorities and other non-traditional students like older adults and single parents has been observed.[20–23] In response to the increasing number of food insecure college students, it is important that researchers and university administrators develop mitigation strategies to reduce and prevent negative health and academic outcomes associated with food insecurity. Institutions of higher learning offer appropriate settings for behavior change interventions. College campuses have a potential to engage large number of students in studies to promote healthy lifestyles.[24] They also have the capacity to support large numbers of students establish healthful habits that may continue throughout life.[25] Furthermore, universities and colleges have facilities and highly trained staff, including health professionals, best suited for executing programs targeting lifestyle modification.[26]

College students are ideal for behavior change interventions using mobile health. Mobile health is the use of mobile devices like mobile phones to deliver education, health and nutrition information, and collect data.[27] Mobile phones provide an opportunity to positively modify behaviors like diet, physical activity and stress management using text messages.[28] A majority of young adults own mobile phones and 89% report having their phones with them all the time.[29] College students report receiving and sending an average of 119 text messages per day.[29,30] With the incorporation of text messaging into the student's day-to-day lives, this technology provides an inexpensive opportunity to deliver evidence-based interventions in a platform that is popular and easily accessed by the target population.[30]

Statement of Purpose

The purposes of this study were to i) investigate the prevalence and risk factors for food insecurity among a sample of college students using cross-sectional study design, ii) explore the lived experiences of food insecure students using semi-structured interviews, iii) use the qualitative data collected to design nutrition messages and test them using cognitive interviews, and iv) conduct a randomized control study to test the efficacy of text delivered nutrition messages in modifying college students' dietary habits, stress management behaviors, and creating awareness of food assistance resources.

Research Questions

1. What is the prevalence of food insecurity among college students enrolled at a public university in southeast United States?

   Objective 1: To investigate the prevalence and identify the factors associated with food insecurity among a sample of college students.

2. What are the lived experiences of food insecure college students?

   Objective 2: To explore the experiences of food insecure college students.

3. Are cognitive interviews useful in testing nutrition messages?

   Objective 3: To test nutrition messages using cognitive interviews and modify them to improve clarity.

4. Are text delivered messages effective in creating awareness of food assistance resources and modifying the eating behavior and stress management behaviors of college students?

   Objective 4 A. To determine the effectiveness of text delivered messages on eating behaviors and stress management in college students.

   Objective 4 B. To create awareness of food assistance resources.

II: LITERATURE REVIEW

MANUSCRIPT 1: FOOD INSECURITY AMONG COLLEGE STUDENTS IN THE UNITED STATES: A MINI REVIEW

A Paper Published in the Journal of Annals of Reviews and Research

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ABSTRACT

The objective of this study was to analyze literature on prevalence, risk factors and consequences of food insecurity among college students in the United States. The authors selected articles published between 1996 and August 2016 utilizing search terms: food insecurity and college students. Eight studies were identified for review. The prevalence of food insecurity among the sampled college students was found to range between 14.0 and 58.8%. Majority of the studies found that race and housing situation are significantly associated with food insecurity. Four studies found that food insecure students are significantly likely to have lower GPA's. Food insecurity is a considerable problem among college students. There is an urgent need for campus administrators and policy makers to come up with programs and safety nets to assist hungry students to facilitate and support their academic success.

Keywords: college students; food insecurity, food security; United States Department of Agriculture (USDA) Household Food Security Survey Module (HFSSM)

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INTRODUCTION

Food insecurity is defined as a circumstance that exists “whenever the availability of nutritionally adequate and safe foods or the ability to acquire acceptable foods in socially acceptable ways is limited or uncertain”. Food insecurity is brought about by circumstantial and economic barriers that bring about challenges that limit access to sufficient and nutritious food by certain populations [1]. Food insecurity is also impacted by lack of food and financial management skills for example food preparation and budgeting for expenses [2].

Per United States Department of Agriculture (USDA), food security can be categorized along a continuum from severe to least severe: very low food security; low food security; marginal food security and high food security. The very low food security category indicates severe food hardship [3]. This means that households or individuals in this category undergo the most acute form of food insecurity measured in the US [4]. Low food security is the less acute form of food insecurity but also indicates that access to adequate nutritious food is challenging. Household members or individuals in this category are often forced to consume nutritionally inferior foods, which lack variety and may be insufficient in quantity because they are economically challenged [4]. Households or individuals that are classified as having marginal food security experience anxiety over potential food shortages, nonetheless they are still able to afford sufficient nutritious foods to consume. Despite experiencing some concern about potential inability to access adequate food, households in this category maintain normal diets throughout the year. Households or individuals in the high food security group have resources to sustain sufficient nutritious diets. These households experience no barriers to accessing nutritionally adequate food and they never face any food shortage. In the US, this is the highest level of food security [4].

The latest statistics on food security in the United States indicate that 14.3% of the total population is food insecure and of that, 5.6% experience very low food security level [5]. There are populations that are disappropriately affected by food insecurity and these include: Black and Hispanic Households (25.1% and 26.2%), low income households with income below 185.0% of the federal poverty guidelines (34.5%) and single-female households with children (36.8%) [6]. Although a small portion of college students comprise these high-risk populations, very few studies have investigated the prevalence of food insecurity specifically among this population [7-9]. Studies investigating prevalence of food insecurity among college students suggests that they experience food insecurity at significantly higher levels than the national average [7, 8]. College students are primarily vulnerable because of the increase in the cost of higher education and recent changes to federal loan policies regarding the duration and total amount of federal aid received translate to budget demands (e.g., textbooks, health care) that compete with food dollar allocation [10]. Undesirable nutrition and non- related nutrition problems have been linked with food insecurity across all age groups [11]. Food insecurity among college students can impact academic performance and health and social outcomes such as poor self-image (8). Addressing food insecurity among college students should be a national priority.

Food insecurity is a public health concern and reducing its prevalence is a national priority as outlined in the *Healthy people 2020* goals. *Healthy people 2020* is a government initiative that bring together individuals and agencies with the aim of improving the health of Americans through health promotion and disease prevention. *Healthy people 2020* has made it a priority to reduce the prevalence of food insecurity in US households from the current 14.5% to 6.0% and to eliminate very low food insecurity in households with children by the year 2020 [12]. Food insecurity is a public health concern and reducing its prevalence is a national priority

as outlined in the *Healthy people 2020* goals. *Healthy people 2020* is a government initiative that bring together individuals and agencies with the aim of improving the health of Americans through health promotion and disease prevention. *Healthy people 2020* has made it a priority to reduce the prevalence of food insecurity in US households from the current 14.5% to 6.0% and to eliminate very low food insecurity in households with children by the year 2020 [13].

Theoretical Framework

The risk factors for food insecurity among college students have not been fully understood because previous studies have mainly focused on low-income households. Alaimo, 2005 proposed a conceptual model for food insecurity. This model outlines: causes, experiences linked to, coping and, consequences of food insecurity [14]. This model proposes that the risk of food insecurity is increased by financial hardship, poor cooking skills, poverty and unemployment. It further proposes that optimization of food resources through knowledge and skills and participation in food assistance programs can improve food security status [1]. Based on Alaimo's (Alaimo, 2005) model of food insecurity and results from a few studies on the prevalence among college students, [7-9, 14] a student specific model was developed by Gaines et.al 2014. This model shows student-specific risk factors which includes increased cost of tuition and housing, low income and inadequate financial and food management skills, increased reliance on borrowed money and ineligibility for food assistance programs [15].

Purpose

There is limited scientific information on the food insecurity levels among college students in the US and most of the available studies' results cannot be generalized to entire campus populations due to small sample sizes [9, 16-18]. The purpose of this study is to provide a review of studies that assessed the prevalence of food insecurity among college students.

Methods of Measuring Food Insecurity

There are currently three scales for measuring food insecurity in the US: Community Childhood Hunger Identification Project (CCHIP) hunger index [19], Radimer Cornell measure of hunger and food insecurity [20] and the US Household Food Security Scale Module (HFSSM): 18 items for households with children; 10-items for households without children; and 6-items short form of the HFSSM [4]. The HFSSM is the most extensively used and validated measure. It is a superior tool because it distinguishes various levels of severity of food insecurity; very low food insecurity, low food insecurity, marginal food insecurity and high food security [4].

Food Security Scoring

The USDA procedures for calculating food security levels are used to determine the participants' food security status; the number of confirmatory answers are counted. Confirmatory answers are counted for answering *often true* or *sometimes true* to the 4-point questions and answering *yes* to *yes/no* questions. The confirmatory answers are summed and the total counts as the participants' score. Scores of 0, 1-2, 3-5 and ≥ 6 mean that the participant has high, marginal, low, and very low food security respectively [3].

METHODS

Literature Search and Inclusion Criteria

The databases PubMed and Education Information Resources Center (ERIC) (1996 to August 2016) were searched for peer reviewed journal articles meeting the pre-set inclusion criteria. The key words used in literature search included: *college students, food insecurity, food security status, institutions of higher learning*, *post-secondary education*, *tertiary institution* and *university students*. The related articles function in PubMed was used to identify additional

studies. The search engine Google scholar and its related articles function was used to search for additional articles. Peer reviewed studies that were conducted within the last 20 years and that reported prevalence of food insecurity among college students in the United States were included irrespective of the study design. Studies were included if they used the HFSSM survey instrument (18 items for households with children; 10-items for households without children; and 6-items short form of the HFSSM) to collect data and characterized their participants as having marginal food security, low food security, and very low food security or as food secure or food insecure.

A total of 28 studies were potentially eligible. A total of 21 studies were excluded because of the following reasons: 10 were conducted outside the United States, 4 were commentaries, 4 were unpublished research, 1 was an opinions and perspectives article and 2 were conducted in community colleges. The review consequently included 8 studies.

RESULTS

Review

A total of 8 studies [7, 9, 15, 16, 21, 23-25] qualified to be included in this mini review. The study characteristics are presented in Table 1 and summaries of key findings of each study are in Table 2. Different variations of the USDA HFSSM instrument were used to collect data for the studies included: 4-item [16], 6-item [9, 21, 23], 10-item USDA HFSSM [7, 15, 25] and modified USDA HFSSM [24]. Most of the studies [7, 15, 21 23] classified food security status into four categories: very low food security; low food security; marginal food security and high food security; and others [9, 16, 25] collapsed the categories into 2: food secure and food insecure.

Gender, Race/Ethnicity and Food Security Status

Female participants were overrepresented in all the studies. Three studies [7, 16, 21] found that security status was significantly associated with race. African American /Black students, Asian and Hispanic/Latino students were more likely to be food insecure as compared to White students [21, 24]. A study [7] that was conducted at the university of Hawaii at Manoa found that Japanese students were more likely to be food secure as compared to Hawaiians, Filipinos, Pacific Islanders, and students with multiple ethnicities.

Housing Situation

Two studies [7, 23] found living situation to be significantly linked to food security status. Students living off-campus with guardians, parents, or relatives were likely to be food secure as compared to students who live on or off-campus alone, with roommate(s) or a spouse [7]. One study [23] found that students who resided in housing where food is not provided were 2.7 times likely to be food insecure. Food insecure students were found to also experience housing instability in one study [16].

Financial Situation and Work for Pay

Financial independence [5] and employment [9, 16] were found to be positively associated with food insecurity. One study [16] reported that students who worked more than 20 hours a week were more likely to be food insecure as compared with students who did not work for pay. Additionally, 38.0 % of food insecure students in one study reported increasing their hours of work to cope with financial hardships. Other food insecure students reported asking for financial support from parents or friends to make ends meet [21]. Further, one study [21] found that 13.0% of food insecure students had difficulties studying because of hunger and no money and were likely to suspend studies due to financial hardship as compared to food secure students (10.0% Vs. 3.0%).

Table 1. Characteristics of Included Studies				
Author (s), reference, Publication date	**Survey instrument**	**Participants**	**Categories of food insecurity reported**	**Region of the United States**
Chaparro et al. [7], 2009	10-Item USDA HFSSM	n=410 sophomores, juniors, seniors	4	Pacific
Patton-Lopez et al. [9], 2014	6-Item USDA HFSSM	n=354 undergraduates	2	Northwestern
Gaines et al. [15], 2014	10-Item USDA HFSSM	n=557 sophomores, juniors and seniors	4	Southeastern
Freudenberg et al. [16)], 2011	4-Item USDA HFSSM	n=2,200 undergraduates	2	Northeastern
Martinez et al. [21] 2016	6-Item USDA HFSSM	n=8,932 undergraduate and graduate students	4	West Coast
Mirabitur et al. [23] 2016	6-Item USDA HFSSM	n=514 undergraduate and graduate students	4	Midwestern
Bruening et al. [24], 2016	2-item modified USDA HFSSM	n=209 freshmen	2	Southwestern
Morris et al., [25], 2016	10-Item USDA HFSSM	n=1,882 undergraduates	4	Midwestern

Breakfast and Eating Patterns

Three studies [16, 21, 25] examined the effects of food insecurity on dietary behaviors and coping mechanisms of food insecure students. One study [25] reported that the odds of consuming breakfast, regular and meals were inversely associated with food insecurity. Collectively, the studies found that food insecure students reported going without meals for the whole day [16], reducing the size and quality of meals [21] of meals because they did not have sufficient funds to buy food. Food insecure students were also found to be more likely to procure food from fast food restaurants than food secure student [21].

Table 2. Summary of Key Findings

Author (s), reference, publication date	Key Findings
Chaparro et al. [7], 2009	Students living off-campus or on campus were more likely to be food insecure than students living with parents or relatives (OR=2.98, 4.96 and 5.01, respectively).
Patton-Lopez et al. [9], 2014	Employed students were more likely to be food insecure (OR=1.73, 95% CI: 1.05-2.88) and students who had GPA ≥3.1 were less likely to be food insecure (OR=0.40, 95% CI: 0.22-0.69).
Gaines et al. [15], 2014	Financially independent students had significantly higher risk for food insecurity (P=0.001).
	Students who tracked their expenses were more likely to be food secure
Freudenberg et al. [16)], 2011	Students working more than 20 hours a week were more likely to be food insecure than those who did not work for pay.
	Food insecure students were 2 times likely to be depressed than food secure students.
	Additionally, 24.3% food insecure students reported housing instability too.
Martinez et al. [21], 2016	Food insecure were more likely to report they had to suspend studies due to financial hardship as compared to food secure students (10.0% Vs. 3.0%).
	Food insecure students (43.0%) reported eating cheap food even if it was not the healthiest.
	13.0% of students reported having difficulties studying because of hunger and no money.

Author (s), reference, publication date	Key Findings (continued)
Mirabitur et al. [23], 2016	Students without car access were 2.7 times more likely to have low food security level than students with car access 95% CI: 1.09-4.59; p=0.03
	Students in housing where food is not provided were 2.7 likely to be food insecure.
Bruening et al. [24)], 2016	Food insecure students had lower odds of eating breakfast as compared to food secure students ($P \leq 0.05$).
	Food insecure students had higher odds of depression (OR 2.97, 95% CI: 1.58-5.60)
Morris et al. [25], 2016	Living situation was significantly associated with food security status ($X^2=42.064$; $p < 0.001$).

Grade Point Average

The correlation between food insecurity and grade point average (GPA) was investigated by two studies [9, 21]. These studies found that food insecure students were significantly likely to have lower GPA's than food secure students. One study (9) reported that students who had GPA ≥3.1 were less likely to be food insecure (OR=0.40, 95% 0.22-0.69). These findings are comparable to the finding that food insecure students reported lower GPA (mean = 3.1) than food secure students mean=3.4; p<0.01 [21].

Anxiety and Depression

Two studies [16, 25] investigated the relationship between food insecurity and depression. Food insecure students were found to have significantly higher odds of reporting depression and anxiety (OR=2.97; 95% CI 1.58 to 5.60 and OR= 1.49;95% CI 0.99 to 6.66) (25) and were 2 times likely to be depressed than food secure students [16].

DISCUSSION

This review assessed prevalence and factors associated with food insecurity among college students in the US. The major factors associated with food insecurity identified include: anxiety, depression, financial hardships, GPA, housing situation, race and work for pay. Other

factors associated with student food insecurity include car access, confidence towards cooking, credit card debt, eating patterns, financial independence, having children, income, marital status, participation in food assistance programs and spending patterns.

Food insecurity exists among college students as a problem that has not received adequate attention. There is very limited information about food insecurity among college students here in the United States and worldwide. The prevalence of food insecurity among college students in the studies under review range from 15.0 to 58.8%, which is higher than the national average (12.7%) [26]. In the past, college enrollment was essentially accessible to people of high economic status, but today it's accessible to people from all social classes including people with low socio-economic status [27, 28] which creates dissonance on data linking poverty and low college attendance and educational outcomes [14, 29].

The risk factors for food insecurity among college students are not limited to economic factors. College students are normally between 18-25 years of age, and often referred to as emerging adults [30]. Emerging adults often lack food management knowledge and skills, and therefore increasing their risk for food insecurity [14, 15]. It is important to implement food and financial management interventions targeting college students, especially Freshmen to improve their food and financial management skills and therefore decrease their likelihood of being food insecure.

Similar to the general population, there exists racial disparity in food insecurity among college students; African American and Hispanic students are at increased risk of being food insecure compared to White students [21, 26]. Additionally, African Americans are more likely to have very low food security status as compared to other races [1]. Further research is needed to determine cultural specific risk factors for food insecurity and thus inform future interventions targeting underserved minority groups.

The cost of higher education over the last 30 years has overtaken the cost of living, inflation and medical costs [10]. Among college students, the budget demands for health care, housing, textbooks, tuition, and utilities compete with the food dollar [31]. Food insecure students report having to choose between paying for food or medicine, educational and housing expenses [21]. Another emerging problem among college students is housing insecurity. Increasing number of college students are at high risk of becoming homeless [32]. An accurate number of students experiencing homelessness is not documented because universities are not mandated to identify or keep track of such cases and due to associated stigma [33]. In 2013, estimates by Free Application for Federal Student Aid (FAFSA) indicated that approximately 58,000 students in higher institutions of learning were homeless nationwide [33]. There is an urgent need to document food and housing insecurity among college students to be able to set up appropriate policy and interventions to assist affected college students.

Food insecurity has been shown to have detrimental outcomes among college students. Food insecurity have negative effects on academic, cognitive, and psychosocial development [14]. A recent study found that food insecurity is a significant predictor of low self-esteem among African American college students [34]. Furthermore, food insecure students have significantly higher odds of reporting depression and anxiety [16, 25]. There are adverse side effects associated with anxiety and depression among college students which include alcohol abuse, physical inactivity, poor sleep habits, poor dietary habits and smoking [35]. These side effects may contribute to poor health, poor academic performance and outcomes.

Food insecurity negatively influences dietary habits. Food deprivation and overeating has been observed in low income, food insecure individuals. As a coping strategy to stretch the food budget, food insecure individuals often skip meals or eat less and when food becomes available,

they often overeat [36, 37]. In a study that sort to establish the relationship of food insecurity and food and nutrient intake, a significant decrease in the intake of fruits and vegetables were associated with increased severity of food insecurity. Furthermore, intakes of fiber, potassium and vitamin C among the food insecure individuals were found to be below the Recommended Dietary Allowance [38]. Although there are no published studies that have explored the relationship of food insecurity and dietary patterns of college students, other studies have found that dietary patterns established during college years are likely to be continued throughout life (39) and insufficient diet during the college years can lead to nutrition related chronic diseases [40].

LIMITATIONS

In the studies under review, cross-sectional study design was used to collect data. In this design, self-reported data were collected, and therefore subject to several shortcomings for example social desirability and recall biases and misinterpretations of questions. The study participants were self-selected and therefore generalizations cannot be made to other student populations in other colleges. In the studies under review, quantitative assessment of food insecurity was carried out and therefore deeper insights into underlying factors contributing to food insecurity remain unclear. There is need to conduct qualitative research (focus group discussions and in-depth interviews) to gain a better understanding of the underlying causes of food insecurity among college students.

CONCLUSIONS

This mini review provides evidence that food insecurity is a significant problem among college students. There is need for a nation-wide assessment of the prevalence and correlates of food insecurity among college students to provide evidence for policy makers to formulate

evidence-based strategies to reduce its prevalence and establish safety nets such as the free and reduced lunch program in the K-12 school system [6]. There is need to conduct longitudinal studies to investigate the impact of food insecurity on academic performance, college completion, and behavioral and social outcomes. Campus administrators should respond to food insecurity among their students by establishing and funding on campus food pantry and creating awareness on food access and student support services to provide them with opportunities for success.

Conflict of Interest

All authors of this article declare they have no conflicts of interest.

Acknowledgements

This research was supported by Alabama Cooperative Extension System (ACES).

REFERENCES

1. Coleman-Jensen A, Gregory C, Singh A (2014). Household food security in the United States in 2013.
2. Anderson K, Swanson J (2002). Rural Families–Welfare Reform & Food Stamps. Policy Brief.
3. Coleman-Jensen A, Nord M, Andrews M, Carlson S (2012) Statistical Supplement to Household Food Security in the United States in 2011.
4. Mark N, Coleman-Jensen A, Andrews M. (2010) Household Food Security in the United States, 2009.
5. Coleman-Jensen, A., Gregory, C., & Singh, A. (2015). Household food security in the United States in 2014. USDA Economic Research Service.
6. Coleman-Jensen A, Nord M, Andrews M, Carlson S (2012) Household food security in the United States, 2011.
7. Chaparro MP, Zaghlou SS, Holck P, Dobbs J (2009) Food insecurity prevalence among college students at the University of Hawai'i at Manoa. Public health nutrition, 12(11): 2097-2103.
8. Hughes R, Serebryanikova I, Donaldson K, Leveritt M (2011) Student food insecurity: The skeleton in the university closet. Nutrition & dietetics, 68(1): 27-32.
9. Patton-López MM, López-Cevallos DF, Cancel-Tirado DI, Vazquez L (2014) Prevalence and correlates of food insecurity among students attending a midsize rural university in Oregon. Journal of nutrition education and behavior, 46(3): 209-214.
10. Phillips (M) Cost of College on the Rise (Again). Freakonomics: The Hidden Side of Everything. http://freakonomics.com/2011/10/27/cost-of-college-on-the-rise-again/. Accessed September 27, 2016.

11. Holben D(2010) Position of the American Dietetic Association: food insecurity in the United States. Journal of the American Dietetic Association, 110(9): 1368-1377.
12. US Department of Health and Human Services, Office of Disease Prevention and Health Promotion, US Department of Health and Human Services, & Office of Disease Prevention and Health Promotion. (2000). Healthy people 2020.
13. Barrett CB (2002) Food security and food assistance programs. Handbook of agricultural economics, 2: 2103-2190.
14. Alaimo K (2005) Food insecurity in the United States: An overview. Topics in Clinical Nutrition, 20(4): 281-298.
15. Gaines A, Robb CA, Knol LL, Sickler S (2014). Examining the role of financial factors, resources and skills in predicting food security status among college students. International journal of consumer studies, 38(4): 374-384.
16. Freudenberg N, Manzo L, Jones H, Kwan A, Tsui E, Gagnon M (2011) Food Insecurity at CUNY: Results from a survey of CUNY undergraduate students. A Campaign for a Healthy CUNY Initiative.
17. Gallegos D, Ramsey R, Ong KW (2014) Food insecurity: is it an issue among tertiary students. Higher Education, 67(5): 497-510.
18. Hadley C, Crooks DL (2012). Coping and the biosocial consequences of food insecurity in the 21st century. American journal of physical anthropology, 149(S55): 72-94.
19. Goetz JR(2008). Exploring food insecurity among individuals with serious mental illness: a qualitative study (Doctoral dissertation, University of Kansas).
20. Radimer KL (2002). Measurement of household food security in the USA and other industrialized countries. Public health nutrition, 5(6a): 859-864.

21. Martinez SM (2016). Student food access and security study. Nutrition Policy Institute.
22. Goldrick-Rab S, Broton K, Eisenberg D (2015) Hungry to learn: Addressing food & housing insecurity among undergraduates. Wisconsin Hope Lab, 1-25.
23. Mirabitur E, Peterson KE, Rathz C, Matlen S, Kasper N (2016) Predictors of college-student food security and fruit and vegetable intake differ by housing type. Journal of American College Health, 64(7): 555-564.
24. Bruening M, Brennhofer S, van Woerden I, Todd M, Laska M (2016). Factors related to the high rates of food insecurity among diverse, urban college freshmen. Journal of the Academy of Nutrition and Dietetics, 116(9): 1450-1457.
25. Morris LM, Smith S, Davis J, Null, DB (2016) The prevalence of food security and insecurity among Illinois university students. Journal of nutrition education and behavior, 48(6): 376-382.
26. Coleman-Jensen A, Gregory C Singh A (2016) Household food security in the United States in 2015.
27. Engle J, Tinto V (2008). Moving Beyond Access: College Success for Low-Income, First-Generation Students. The Pell Institute for the Study of Opportunity in Higher Education. Washington, DC.
28. Eagan K, Stolzenberg, EB, Ramirez JJ, Aragon, MC, Suchard MR, Hurtado S (2014) The American freshman: National norms fall 2014. Los Angeles: Higher Education Research Institute, UCLA.
29. Worthy SL, Jonkman J, Blinn-Pike L (2010) Sensation-seeking, risk-taking, and problematic financial behaviors of college students. Journal of Family and Economic Issues, 31(2): 161-170.

30. Robb CA, Moody B, Abdel-Ghany M (2012) College student persistence to degree: The burden of debt. Journal of College Student Retention: Research, Theory & Practice, 13(4): 431-456.
31. Ringer BD (2015) College students experiencing homelessness: The consequence of failed macro policies. McNair Scholars Research Journal, 8(1): 9.
32. Gross L (2013) College campuses see rise in homeless students. USA Today.
33. Peters Jr RJ, Ford K, Meshack A, Johnson RJ, Hill M, Peters RJ (2013) The relationship between perceived psychological distress, behavioral indicators and African-American female college student food insecurity. American Journal of Health Studies, 28(3).
34. Doom JR, Haeffel GJ (2013). Teasing apart the effects of cognition, stress, and depression on health. American journal of health behavior, 37(5): 610-619.
35. Bruening M, MacLehose R, Loth K, Story M, Neumark-Sztainer D (2012) Feeding a family in a recession: food insecurity among Minnesota parents. American Journal of Public Health, 102(3): 520-526.
36. Olson CM, Bove CF, Miller EO (2007) Growing up poor: long-term implications for eating patterns and body weight. Appetite, 49(1): 198-207.
37. Kendall A, Olson CM, Frongillo EA (1996). Relationship of hunger and food insecurity to food availability and consumption. Journal of the American Dietetic Association, 96(10): 1019-1024.
38. Brown LB, Dresen RK, Eggett DL (2005) College students can benefit by participating in a prepaid meal plan. Journal of the American Dietetic Association, 105(3): 445-448.

39. Winkleby MA, Cubbin C (2004) Changing patterns in health behaviors and risk factors related to chronic diseases, 1990–2000. American Journal of Health Promotion, 19(1): 19-27.

40. Nelson MC, Story M, Larson, Neumark-Sztainer D, Lytle LA (2008) Emerging adulthood and college-aged youth: an overlooked age for weight-related behavior change. Obesity, 16(10): 2205-2211.

Prevalence and Trends of Food Insecurity in the US

Food insecurity is a common phenomenon in the US. In 2016, 12.3% of US households were food insecure; that number is essentially unchanged from 12.7% in 2015. A significant cumulative decline in the prevalence of food insecurity was observed from 2011 (14.9%) to 2014 (14%) and this decline continued to 2016 (12.3%). Very low food security category percentages went relatively unchanged from 5% in 2015 to 4.9% in 2016.[31] The trends in US food insecurity between 2001 and 2016 are illustrated in Figure 1.

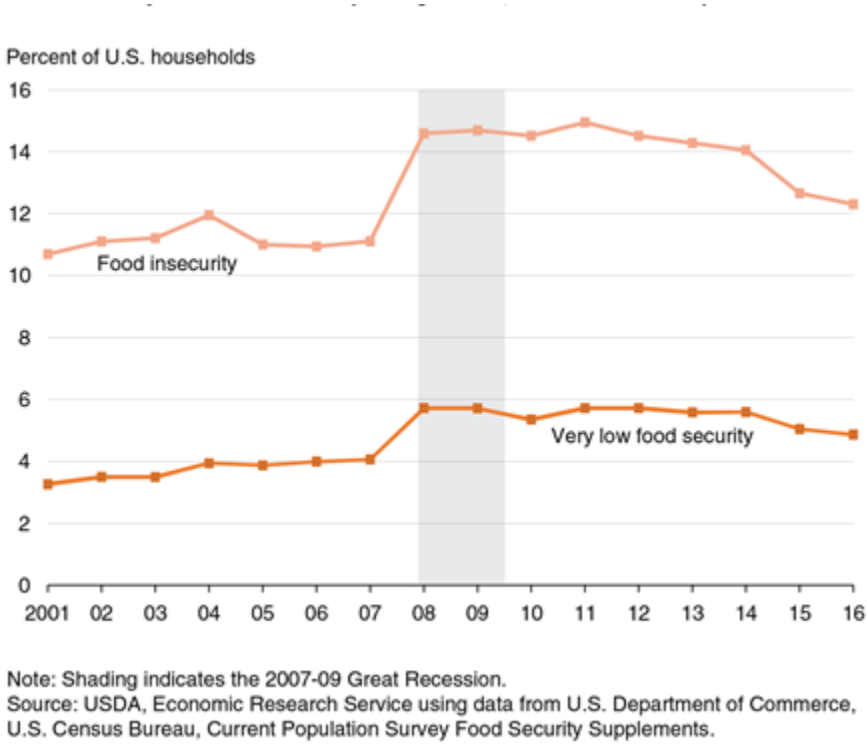

Figure 1. Trends in prevalence of food insecurity and very low food security in US households, 2001-2016.[31]

Predictors of Food Insecurity among College Students in the US

Race/Ethnicity

Food insecurity disappropriately affect some population groups. Previous studies on food insecurity among college students have found that Hispanic, non-Hispanic Blacks and students from other minority groups are at higher risk for food insecurity compared to White students.[3,6,16,2] These findings are consistent with the 2014 national data which reported that the prevalence of food insecurity among African Americans (26%) and Hispanics (22%) is higher than Whites (11%).[6] In the general population, households headed by single-female, Hispanic, Black Americans and households with children have been found to have increased risks for food insecurity.[32]

Finances/Income

Among college students, the cost of housing, healthcare, tuition and textbooks contribute to increased risks for food insecurity.[1,33] With the increased cost of tuition and increase in enrollment of low-income first-generation students, the likelihood of increased number of food insecure college students increases. Similarly, within the general population, poverty, poor health, medical costs, limited access to food assistance resources, housing and utility costs are some of the factors that contribute to food insecurity.[34,35] Households with income at or below 185% of the federal poverty guidelines are at increased risk for food insecurity.[36]

College students often referred to as emerging adults often have unstable finances. To keep up with the increasing cost of tuition and attending college, they often accrue student loans and credit card debt.[37,38] Students often use credit cards for unforeseen financial needs and purchase of food.[38] College students may be classified as financially-at-risk because their financial management skills are often in question and they lack sufficient income to meet the

debt obligations and therefore, increase the risk for food insecurity.[1] One study that was conducted in Australia found that 22% of the sampled students borrowed money from family, friends and financial institutions to purchase food.[16] Similarly, a study that examined the role of financial factors in predicting food security status among college students found that 45% of the study participants owned credit cards.[1] Access to borrowed money and credit cards may solve immediate financial needs but may adversely affect future finances and food security status.

Living Arrangements

The living arrangements of college students have been found to be an important risk factor for food insecurity.[3] Students who live on- or off-campus with roommates have been found to have higher risks for food insecurity.[1,3,6] In contrast, students who live with their parents, spouses or relatives have lower risks for food insecurity and this may be attributed to lower housing costs.[3] Results from a study conducted in at the City of New York found that 42% of the students were housing insecure.[39] Similarly, in a study that survey undergraduates in 10 community colleges found that 50% of the students were housing insecure with 13% being homeless.[40] In both studies, students faced housing and food insecurity.[39,40]

Food Resource Management Skills

Lack of food resource management skills has been shown to increase the risk of food insecurity.[35,41] College students aged between 18-25 years are often referred to as emerging adults often lack knowledge and skills required for food preparation.[42] In a study that was conducted at the University of Alabama to examine food security and its risk factors, students with high food security had significantly ($P< 0.05$) higher cooking self-efficacy when compared to the food insecure students. Students with low food security reported low food resource adequacy as compared to their food secure peers.

Impacts of Food Insecurity on Dietary Intake, Sleep and Mental Health

Dietary Intake

Food insecurity is characterized by reduced desirability, variety, quality and quantity of food.[43] Previous studies conducted in the general population have linked food insecurity with reduced intake of healthy foods and poor diet quality; for example, reduced intake of fruits and vegetables.[44,45] Food insecurity can bring about "substitution" effects where higher quality food items like lean proteins and produce are substituted with energy dense food items high in fat and refined sugars.[46] Among low-income adults, food insecurity is associated with intake of added sugars, high-fat dairy products, salty snacks and sugar-sweetened beverages.[46,47] Food insecurity is also associated with over eating and increased intake of fast foods.[48]

One recent study that was conducted in a large, mid-Atlantic university found that food insecure students were more likely to report eating less food, being hungry and unable to eat a balanced meal due to inadequate financial resources to acquire food in the past one year.[5] Dietary patterns established during college years are likely to be continued throughout life.[49] Additionally, an insufficient diet during the college years can lead to nutrition related chronic diseases.[50] Interventions targeting this cohort are warranted to help this group maintain a healthy diet and therefore prevent future health complications.

Sleep

Food insecurity is associated with negative health outcomes including insufficient sleep. In a study that was conducted to determine the relationship between insufficient sleep, recurrent mental distress, food and housing insecurity among US adults, insufficient sleep was more prevalent among those who experienced food and housing insecurity as compared to those who did not, 38% vs 22% and 41% vs 23%, respectively.[51] In another study conducted in a mid-Atlantic university, at risk and food insecurity students reported sleeping lower number of hours

per day (6.37 and 6.44 hours per day, respectively) as compared to their food secure (6.9 hours/day) peers. A significantly (P=0.018) high percentage of at risk and food insecure students reported having trouble falling or staying asleep.[5] Insufficient sleep may be caused by hunger or mental distress caused by food insecurity.

Anxiety, Depression and Stress

The transition to college is marked with increased anxiety, depression and stress.[52] College students face a myriad of stressors including personal health problems, academic performance, social relationships, finances and personal appearance.[39] In the adult population and among college students, food insecurity has been linked to mental health conditions such as aggression, anxiety and depression.[16,36] One recent study reports significantly (P< 0.001) high percentage of at-risk and food insecure students report more frequent symptoms of depression (feeling tired, feeling down, little interest, poor appetite, and feeling bad about oneself) as compared to food secure students. Food insecurity has also been associated with poor self-image and low self-esteem among college students[16,19] and this may be an added cause of stress. Anxiety and stress is associated with harmful behaviors like alcohol abuse, smoking, physical inactivity, poor sleep habits and poor dietary habits.[53,54] The adverse side effects associated with anxiety and stress validate the need to come up with interventions to manage and prevent these conditions among college students.

Food Assistance Resources

The US government through the US Department of Agriculture established the largest food and nutrition assistance programs, Supplemental Assistance Program (SNAP) and National School Lunch Program (NSLP) for adults and school children, respectively.[31] These programs were established to provide safety nets for food insecure individuals. Unfortunately, such safety

nets are not provided directly to food insecure college students. Most full-time college students are ineligible to qualify for the SNAP benefits.[3,55] In order for college students to qualify for SNAP benefits, they must have one or more dependents between the ages of 5-12 years and have no childcare, work a minimum of 20 hours a week and participate in work-study programs.[36]

There are donor funded organizations such as food banks and food pantries which offer food assistance to individuals and households in need. However, there are barriers to utilization of community food pantries by college students including access and protocols by food pantries requiring documents of permanent residency (utility bills), which is a challenge for students residing in dorms and that all members of the household should be served together. In the recent years, there has been growing number of universities establishing on-campus food pantries to serve students in need.[7] Available data indicate that some college students may not be aware of food assistance resources available on campus.[16] Finally, like the general population, students may face stigma associated with seeking food assistance. One study that investigated the perceptions of college students using food stamps (currently referred to as SNAP) during the switch from paper to Electronic Benefit Transfer (EBT) found that 67% of students reported less embarrassment and stigma with use of EBT card.[56] It is therefore important to develop interventions that will help create awareness of food assistance resources and encourage conversations about the subject of food insecurity among college students.

Text Messaging Interventions for Behavior Change

The utilization of mobile phones is growing at a rapid rate and especially among young adults.[29] Mobile phones are used for multiple purposes including interpersonal communication, internet access, data collection and delivery of nutrition education and health information.[30] Mobile phone technology is increasingly used to promote health.[28] Mobile phone technologies

that have been utilized for health promotion include voice calling, video messaging and text messaging.[57] Mobile phone text messaging or texting is a powerful modality for behavior change because of several reasons; its cost-effective, it does not require great technological expertise, it is instant, it can be accessed at any time and it is widely available.[30]

Text messaging is fully ingrained in the lives of college students.[28] According to PEW research (2010), 94% (n=273) of college aged students (ages 19-26) reported having a cell phone and preferred text messaging or texting as a means of communication.[29] Approximately 90% of college aged students reported having their mobile phones all the time including bedtime.[29] With the integration of text messaging in the daily lives of college students, this technology provides a modality through which evidence-based content can be provided via a platform that is widely acceptable, accessible and frequently used.

Results from research studies testing the use of text messages to promote the adoption of healthy behaviors have shown promising results. However, most studies that have been conducted using text messages to influence nutrition-related behaviors have focused on weight loss or diabetes.[27,58–60] Although weight loss and diabetes management are nutrition related, their methods are not necessarily related to the aims of this study. However, it is important to note that these studies were successful in using text messages to improve weight loss and diabetes management.

A 10-weeks randomized control trial was conducted in four universities in East Coast Malaysia using multimodal (brochures, conventional lectures, and text messages) design to deliver nutrition intervention to improve dietary intake among university students.[61] Four hundred and seventeen students aged between 19-24 years participated in the study. The participants were randomly assigned to intervention (IG) and control groups (CG). The IG were

exposed to brochures, conventional lectures, and text messages over a 10-week period whereas the CG did not receive any intervention material. Dietary intake was assessed before and after intervention and average daily servings of food and nutrient intake were evaluated. One-hour conventional lecture was delivered with the aid of PowerPoint presentation and question and answer session was conducted in conjunction with the lecture. After the lecture, the participants were provided with brochures to take home. The brochures contained key recommendations and guidance on how to achieve each recommendation. The brochures were meant to enhance participants understanding and memory of the information provided during the lectures. The intervention group received a total of 13 text messages based on Malaysian Dietary Guidelines every 5 days, for 10 weeks. At post-intervention, the intervention group significantly ($p=0.006$) increased their energy intake when compared to the control group. Compared to the control group, the intervention group significantly reduced their intake of processed food at the same time increased their intake of fish, eggs, calcium, thiamine, fruits and 100% fruit juice. Although the results cannot be generalized to US college students due to the sample being Malaysian college students, they support the idea that use of multimodal nutrition education intervention including text delivered messages are effective in improving dietary intake of the targeted population.

A 7-week pilot study dubbed Mobile MyPlate was conducted in Purdue university, Indiana to evaluate the acceptance and efficacy of text delivered messages in in improving the nutrition knowledge and fruit and vegetable consumption of sampled college students.[62] Inclusion criteria included full-time undergraduate students aged between 18-24 years, not currently enrolled in any nutrition course, non-nutrition, exercise science and/or kinesiology major, and have access to phone with multimedia messaging service (MMS). The participants

were randomly assigned to the intervention or control groups by order in which they enrolled in the study and gender. The intervention and control participants completed pre- and post-intervention surveys that included a screener, consent form, demographic information, self -reported food frequency questionnaire and MyPlate recognition assessment. The intervention group received 2 text repetitive messages per week for 7 weeks. Each text message consisted of the MyPlate icon and 1 behavior-directed motivational Dietary Guideline message. At the beginning of the study, the control group received a brochure containing the MyPlate icon and the behavior-directed motivational messages. At 7 weeks, there was 77% retention rate with 62 intervention group and 54 control group participants completing the post intervention survey. Results showed that there was significantly greater percentage of intervention participants who recognized MyPlate food groups ($p < 0.05$). The intervention group significantly increased their intake of fruits when compared to the control group ($p < 0.05$). Most of the intervention participants reported that the text messages helped them stay focused on their health and that text messages were a great process of receiving health related information. Mobile MyPlate was determined to be acceptable and effective in increasing awareness of MyPlate icon and in improving eating behavior of college students.

Another study in the United Kingdom (UK) aimed at testing if the effects of implementation intentions on exercise can be enhanced using text messages among university students.[63] Eligibility criteria were that the participants must: be aged between 18-40 years, fluent in English, own a cell phone and exercise less than 3 times a week. A computer-based random number generator was used to randomize the participants to any of the 5 groups: control, control 2, implementation intentions, SMS (short message service) and implementation intentions + SMS. Participants in the control group completed the measures of motivation,

control 2 (PMT) participants read a motivational message designed to manipulate each component of PMT (Protection Motivation Theory). The implementation intentions, SMS and implementation intentions + SMS groups also read the motivational message and therefore control 2 is a natural control in this study. The implementation intentions group read the PMT-based message and then formed their implementation intentions-the exercises they would like to do for 3 days per week and for at least 20 minutes. They were also asked to make a list of all possible daily situations that would help facilitate their plans to exercise for example "As soon as lectures end on Tuesdays, Thursdays and Fridays then I will go to the gym and workout". The SMS group read the PMT message, made a list of implementation intention (s) and then they were asked to decide the type and number of messages they would like to receive in their mobile phones to remind them to exercise. The SMS group participants were also allowed to choose the content of the text messages they would like to receive. The implementation intentions + SMS group received the same instructions as the implementation intentions group and the same SMS manipulation as the SMS group only with an addition of text messages to remind them of their implementation intentions. Exercise behavior was assessed at baseline and 4 weeks follow-up. A total of 155 participants with a mean age of 23.86 years participated in this study. The results suggest implementation intention + SMS is more effective in increasing exercise as compared to their other treatments. The text reminders of ones' implementation intentions positively changed the participants exercise behaviors by increasing their commitment to their plan. This study demonstrates that implementation intentions and text message reminders were effective in changing health behavior.

An eight-week weight loss Facebook and Text Messaging intervention was designed in a large eastern United States university and evaluated to determine its acceptability, feasibility and

efficacy among college students.[30] Inclusion criteria included college students age 18-29 years, BMI 25-50kg/m^2, determined by a physician to be healthy enough to participate in physical activity and lose weight safely, an active Facebook user and have a mobile phone plan with unlimited texting. Participants (n=52) were randomly assigned into one of 3 conditions: 1) Facebook, 2) Facebook Plus (included text messaging and personalized feedback), or 3) Waiting list control group. Participants in the Facebook and Facebook Plus groups received invitation to join separate private Facebook groups where they had access to handouts and podcasts for weekly topics. The Facebook Plus group received additional theory driven targets that included goal setting, self-monitoring and social support delivered via text messaging. Additionally, the Facebook Plus group received *Calorie King book,* measuring utensils, a pedometer and a digital scale. They also received daily text messages, personalized weekly reports and a support "buddy". Demographic information including age, gender, race and school year was assessed at baseline. Height and weight measurements were taken at baseline and BMI was calculated. Additional weight measurements were taken at 4 and 8 weeks. Secondary outcomes including physical activity behavior, goal setting and planning, physical activity self-efficacy, weight self-efficacy, adapted social support for diet and exercise, compliance and consumer satisfaction were assessed at baseline and 8 weeks. Results showed that the participants in the Facebook Plus (text messaging and personalized feedback) had significantly ($P < 0.05$) greater weight loss (-2.4±2.5 kg) than the Facebook (-0.63±2.4 kg) and Waiting List groups (-2.4±2.6 kg). There were no significant differences within or among groups in the physical activity measures. Ninety three percent of Facebook Plus participants reported that text messages were useful. Future directions indicate that text messages should be tailored to time of day (early morning, late-night snacking,

weekends, and during finals) and high-risk behaviors. Technology based interventions may have increased potential to reach large numbers of individuals and make public health impact.

A 6-week sleep hygiene study was designed and conducted in a Southeastern university (US) with the aim of testing the efficacy of text message intervention in promoting sleep hygiene, quality and knowledge among college students.[64] The intervention and attention (control) groups received 2 bi-weekly messages about sleep hygiene and healthy habits, respectively for 6 weeks. At baseline and at posttest, the participants completed a survey that included demographic information, sleep knowledge test, sleep hygiene, self-efficacy for sleep hygiene and sleep quality. The intervention group also evaluated the text delivered intervention at post-test. A total of 111 (92.5%) participants competed the 6-week intervention. The participants had an average of 7.93 ± 1.20 hours of sleep and 78% of study participants reported good sleep quality at posttest. At the end of the study, 66% of participants reported that text messages motivate them to practice good sleep behaviors. Text messaging is a viable method of delivering health promotion interventions to college students.

Limitations in the Literature

The literature lacks research using qualitative study approaches such as in-depth interviews to explore the lived experiences and coping strategies of food insecure college students. Instead, the majority of research has been conducted using quantitative approaches such as cross-sectional study design to investigate the prevalence and factors related to food insecurity among college students.

Few studies have examined the effects of food insecurity on dietary habits, sleep and mental health (anxiety, depression and stress) among college students. Several studies have reported that universities are responding to the issue of student food insecurity by establishing

on-campus food pantries to assist the affected students. Additionally, one current study assessed predictors of food assistance resource use but there has been no study aimed at creating awareness of such resources.

The literature lacks intervention studies that have utilized the "voices" and the lived experiences of food insecure students to design health related messages to promote health. Furthermore, there are no intervention studies that have been conducted to modify dietary habits, stress management and create awareness of food assistance resources among college students.

III: METHODOLOGY

Cognitive Interviews

Nutrition and other health professionals are often tasked with the responsibility of developing and communicating nutrition and health education information. However, the ability of the educational materials to change the desired behaviors depend upon their appropriateness, acceptability and understandability by the target population. A pilot test of health messages do not always reveal problems with language wording, which may prevent effectiveness. However, cognitive interviews are useful approach to detect and address potential problems in the early phase of health and nutrition message development.[65] Cognitive interviewing is a technique where interviewees verbalize their feelings, thoughts, interpretations, and ideas as they examine survey questions or messages.[66] Cognitive interview techniques have been used in the development of interactive nutrition messages for low income populations, and testing of food security questionnaires.[65,67] Cognitive interviews are useful in the field of nutrition because of the need to communicate complex nutrition information that are understandable and acceptable to the targeted audience.

The cognitive interview technique is grounded in information processing techniques and cognitive psychology. The first study to demonstrate the effectiveness of cognitive interview in determining the effectiveness of message (s) was conducted approximately fifty years ago.[68] In the development of the messages, interviewees are asked to propose alternative wording to improve readability, understanding and relevance of information. Messages are more likely to be accepted if they were personally relevant and fit into an audiences' understanding.[69,70]

Two major strategies for conducting cognitive interviews are: thinking aloud and probing.[71] With the think aloud approach, interviewees are asked to verbalize all their thoughts as they respond to a survey question or read an educational message. In probing, interviewers use spontaneous or scripted questions designed to prompt detailed information beyond that normally provided by interviewees; used immediately after individual survey item or message, or after the completion of the entire survey.[72] Another technique used for conducting cognitive interviews is paraphrasing; interviewees are asked to repeat a survey item or message in their own words. The three approaches have also been used together.[65]

Development of Nutrition Messages

The development of the nutrition messages followed a qualitative study conducted using in-depth interviews among food insecure students in Spring 2017.[73] During the in-depth interviews, the interviewees were asked to describe: their personal crisis when they did not have enough food and the steps they took to acquire food; how hunger affects them as students; how they plan and budget for meals and what they consider when they plan and budget for meals, how they go about their grocery shopping – sections of the store and what their healthiest and unhealthiest dietary habits are and what prevents them from having healthier habits. The researchers reviewed the findings on lived experiences and coping mechanisms adopted by the food insecure students and identified possible modifiable nutrition and health related intervention areas:

- Dietary habits: fruit and vegetable intake, intake of sugar sweetened beverage, mealtime behaviors (planning for meals and snacks, and mindful eating), dietary fats/oils and whole grains.
- Stress management behaviors: sleep and physical activity.

- Food assistance resource awareness.

Steps Followed in the Development of Nutrition Messages:

Literature Review

An online search and review of existing nutrition and health information was conducted and relevant messages from Project YEAH and USDA Choose Myplate.gov website were identified.[74–76] Project YEAH (Young Adults Eating and Active for Health) was a theory-based web-delivered intervention to prevent undesirable weight gain in young adults.[76] Choose Myplate.gov is a multicomponent communications website that provides current dietary and physical activity guidelines.[75] Messages relevant to dietary habits and stress management behaviors intervention areas were identified by the literature review.

Message Selection and Modification

An initial pool of 30 messages from Project YEAH and USDA Choose MyPlate were selected. The messages were then scrutinized for relevance to the identified intervention areas (dietary habits, stress management behaviors). A total 12 messages that were found to be similar or not directly related to the objective items of the intervention areas were eliminated. Messages to encourage healthful dietary habits and stress management behaviors were used as they are or adapted to meet communication objectives of the current study. Modification of the messages included decreasing the length of some messages to make them succinct, adding phrases, for example “slow down!” to catch the intended audience attention and changing some messages to questions by using “Did you know...?” statements.

Messages to create awareness of food assistance resources were originally developed by the researchers as literature search did not yield any relevant communication materials. The researchers formulated messages that direct participants to places on campus that offer

supplementary food (food pantry and Campus Kitchens), the hours that these places are open, contact information of the food pantry and list of campus dinning places that offer value menus. A total of 21 messages were developed, within that, 14 were messages under dietary habits, 4 under stress management and 3 were for food assistance resource awareness.

Human Subjects Approval

Protocols in accordance with Auburn University Institutional Review Board for Research Involving Human Subjects (IRB) were followed throughout the study. An informed consent letter describing the study, the right to withdraw from the study at any time without consequence were voluntarily signed by participants before the cognitive interviews (Appendix A).

Study Design and Participants

Participants were recruited outside classrooms and in on-campus food pantry using a printed invitation letter (Appendix B). Eligibility included being 19 years or older and enrolled in the semester in which the study was being conducted. The participants received $10 for their participation.

Nine individual face-to-face cognitive interviews were conducted privately in a closed laboratory by one researcher. Each interview lasted approximately 45 minutes. The participants were asked to read the messages and verbalize their feelings, thoughts and interpretations when reading the nutrition messages. They were also asked to paraphrase the messages and propose alternative wording. Additionally, the researcher used spontaneous verbal probes to elicit the participants understanding and interpretation of the messages and to pursue issues raised by the interviewees to clear any confusions. All interviews were audio recorded using an audio recorder.

Data Analysis

Audio recordings from the cognitive interviews were transcribed verbatim by the researcher. The transcripts of the cognitive interviews were managed using a qualitative data software program, Atlas.ti. (Scientific Software Development, Berlin, Germany). The researcher then conducted a thorough systematic review of data on each item/message and developed a codebook.[77] Two researchers who were not familiar with qualitative data coding were trained using interview data and a codebook from another qualitative study. The objective of training the researchers was to familiarize them with the process of qualitative data analysis. The two researchers were further trained with the already developed codebook and quotations from the cognitive interviews. The trained researchers then coded data from one cognitive interview and the inter-analyst agreement was 80%, which meets the established standards.[78] This was done with the intent of using the results of the analysis to guide researchers on which items in the messages to keep, delete or modify. Items that were consistently understood and interpreted in the same manner by all the interview participants were retained; others were revised.

Five key themes emerged from the qualitative data analysis. They were: 1) clear messages, the participants said that some messages were "clear and concise" and they understood them and there was no need of any modifications; 2) more information needed on functions of nutrients; 3) provide examples of whole grains, the participants were not sure which foods provided whole grains; 4) ambiguous terms, some terms were found to be unclear by some of the participants; and 5) variable interpretation of terms, some familiar terms were interpreted differently by the participants. Table 1 provides a list of themes, examples of problems identified and an illustration of how words and phrases were modified, and implications of these changes.

The messages were modified to incorporate the emerging suggestions and corrections in wording of the nutrition messages. Two round table meetings with a team of researchers (n=4) were held to further refine the nutrition messages. In the first meeting, the researchers read the theme (s) that emerged from each message and compared the original and modified messages to ensure that all problems were identified, and changes made accordingly. In the second meeting, the researchers (n=2) read through the messages one by one to further check for clarity issues and to make sure all suggested modifications were made. Table 1 provides a list of themes, messages, examples of problems identified and an illustration of how words and phrases were modified by the researchers to improve message clarity.

Table 1. Original and Modified Nutrition Messages

Original Message	Problems Identified by Cognitive Interviews	Action (s) Taken	Modified Message
More Information Needed on Functions of Nutrients			
Fruits and vegetables provide dietary fiber, folic acid, vitamins A & C and potassium that PROMOTE HEALTH.	Participants said they did not know how dietary fiber, folic acid, vitamins A & C and potassium promote health. They expressed need for more information on the functions of the mentioned nutrients in the body.	Added functions of provide dietary fiber, folic acid, vitamins A & C and potassium in the body.	Fruits and vegetables provide dietary fiber, folic acid, vitamins A & C and potassium that PROMOTE GOOD HEALTH. •Dietary fiber-Reduce blood cholesterol and aid in proper bowel movement. •Folic acid -Help form red blood cells. •Vitamin A-Keeps eyes and skin healthy and helps to protect against infections. •Vitamin C-Important for growth and repair of body tissues.

Table 1. Original and Modified Nutrition Messages (continued)			
Original Message	**Problems Identified by Cognitive Interviews**	**Action (s) Taken**	**Modified Message**
Incorporate Examples in the Messages			
Optimize your heart health: eat more whole grains every day	Participants did not know which foods provide whole grain	Added examples of whole grains Replaced "optimize your heart health" with "choose whole grains".	Choose whole grains like brown rice, whole grain pasta or whole wheat bread over refined products
Engaging in your favorite physical activity (swimming, yoga, walking, running) is a great way to reduce stress	Participants expressed concern that physical activity can be intimidating to some students and they suggested that we should give examples of easy activities that can be incorporated in daily routines	Added examples of physical activity that can be incorporated in daily routine	Engaging in your favorite physical activity (swimming, yoga, walking, running) is a great way to reduce stress. •Walk briskly to class, take the stairs instead of the elevator. •Remember that even 10 minutes of exercise is beneficial.
Unclear Terms			
Promote your health: eat more fruits and vegetables every day	Participants expressed confusion about the meaning of the word "more"	The word "more" was replaced by "make half your plate fruits and vegetables	Promote your health: make half your plate fruits and vegetables. Eat a variety of fruits and vegetables
Variable Interpretation of Terms			
Optimize your heart health, eat healthy fat. Fish, nuts and liquid oils like olive, corn, soy and canola oil are examples of foods with healthy fats. Choose lean meat, fish and poultry, low fat or fat-free milk and milk products, and drain excess fat.	Participants expressed concerns on the interpretation of "lean meat." For some, lean meat referred to meat with no visible fat. Others thought meat labelled 80% lean is lean "enough"	Clarified definition of "lean meat" Message was shortened to be more concise	Optimize your heart health by eating healthy oils. Fish, nuts and liquid oils like olive oil are examples of foods with healthy oils. Choose lean meat, fish, poultry and low-fat milk. Choose greater than 90% lean meats

IV: MANUSCRIPT 2

PREVALENCE AND RISK FACTORS FOR FOOD INSECURITY AMONG STUDENTS ATTENDING A PUBLIC UNIVERSITY IN SOUTHEAST UNITED STATES

A Paper Submitted to the Journal of SAGE Open Medicine

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ABSTRACT

Background: There is currently no national data on the prevalence of food insecurity among college students in the United States. There is need to conduct studies to establish prevalence and factors associated with food insecurity in different campus settings. **Objective:** To investigate the prevalence and factors associated with food insecurity among students attending a public university in southeast United States. **Methods:** An email delivered cross-sectional non-probability survey of 990 students was conducted in October to December 2016. **Results:** Thirty one percent of the surveyed students were food insecure, with 14% defined as having "very low food security" status. Living on campus alone (odds ratio [OR], 1.826; 95% CI, 0.787, 4.235) and smoking 6-11 cigarettes a day (OR, 2.256; 95% CI 0.208, 24.504) were associated with food insecurity. Very few food insecure students reported utilizing food assistance programs. **Conclusion:** Food insecurity is an important issue among college students at attending a public university in Southeast United States. It is necessary for the university to respond by establishing on-campus food pantries Further research is required to assess lived experiences of food insecure students to better understand the impact of food insecurity on the affected students.

Key words: College Students, Food Security, Food Insecurity

INTRODUCTION

Approximately 41 million Americans lived in food insecure households in 2016[1] despite the reported prevalence of food insecurity (FI) in the United States (US) having significantly decreased between 2014 and 2016. FI exists when households have economic and social conditions that limit their access to enough food for an active and healthy lifestyle.[1] Among college students, FI is an emerging issue of concern and a recent systematic review estimates that an average of 42% of college students are food insecure.[2] Literature indicates that the risk factors for food insecurity among college students include: race/ethnicity, enrollment status, residence/living arrangements, financial status, financial and food management skills.[3–9]

For college students, food insecurity is associated with 1) poor dietary habits, 2) poor mental health and 3) poor academic outcomes. Concerning poor dietary habits, FI can bring about "substitution" effects where higher quality food items like lean proteins, fruit and vegetables are substituted with energy dense food items high in fat and refined sugars, overeating and increased intake of fast foods.[10–12] Compared with food secure students, food insecure students report skipping meals especially breakfast,[13–15] cut the size of their meals[15] and report lower intake of fruits and vegetables.[11,16] For mental health, anxiety, low self-esteem and stress have also been positively linked with food insecurity among these cohorts [15,17–19] and finally regarding low academic outcomes, studies have shown that FI leads to poor concentration in class and lower grade point average (GPA).[6,15,20,21]

In the general population, addictions such as drinking, gambling and smoking have been shown to play a role in FI by competing with other household expenses and straining household income.[22] In a past study that explored the association between cigarette smoking and food insecurity among young adults aged 18-30 years, smoking prevalence was found to be

significantly higher among the food insecure as compared to the food secure,[23] similar findings have been documented among low-income families.[24] Considering that FI and cigarette smoking are independently associated with poor health, [10,11,24–26] it is therefore important to investigate if food insecurity is associated with cigarette smoking among college students.

To combat food insecurity among Americans, the federal government has an established supplementary nutrition assistance program (SNAP) that provide food and nutrition assistance to eligible households.[1] Most college students are ineligible to receive SNAP benefits because of the strict federal regulations that requires a student to work at least 20 hours per week, participate in state or federal work study program, have dependent (s) younger than 6 years and/ or receive public assistance benefits under a Title IV-A program.[27] That creates an opportunity where universities and colleges respond to food insecure students for instance, by establishing on-campus food pantries. According to College and Food Bank Alliance (CUBFA), an organization that support the establishment of on-campus food pantries, the number of registered member institutions tripled to 573 between 2015 and 2017.[28]

The existing literature on prevalence of FI among college students in the United States (US) is not generalizable to the entire college student populations in the country due to small sample sizes, difference in geographical regions, type and size of colleges. There has been growth of research concerning food insecurity among college students,[2,14,21,29,30] however, there is need to explore the topic to gain deep insights into the unique factors and consequences of food insecurity in different colleges situated in different regions across the country. To the best of our knowledge, there has been only three studies that have examined prevalence and factors associated with food insecurity among college students in southeast region of United States.[9,30,31] Our findings will highlight the issue of food insecurity among college students in the region and

will be used to inform university administrators, state and federal agencies for the stakeholders to strengthen student support systems and influence policy change.

The goals of this research were: (1) to assess the prevalence and factors associated with food insecurity among college students attending a public university in southeast United States and (2) to inform university administrators and researchers on the existence of the problem and to provide empirical evidence for planning for institutional response.

METHODS

Sample and Study Design

We calculated our sample size using the formula [32], $n = \frac{z^2 P(1-P)}{d^2}$ [32] where n is the sample size, Z is the level of confidence (90%), P is the expected prevalence (14% was used based on the lower end of the prevalence reported in a similar study conducted in southeast US[9]) and d is the precision (0.01 was used). The number of participants estimated to be needed for our study was 975.

This cross-sectional study was approved by the university's Institutional Review Board. Data were collected October 2016 through December 2016 using anonymous, nonprobability, online surveys hosted by qualtrics.com. The survey was circulated via email to 16,714 students (juniors, seniors and graduate) enrolled in the Fall semester, 2016. The email contained an informational letter and a link to the survey (Appendix C). Completion of the survey was considered consent to participate in the study. The online survey was open for three months during which one reminder was sent.

Measures

Food security status was assessed using the 10-item United States Department of Agriculture Adult Food Security Survey Module (USDA AFSSM).[33] This survey is designed to evaluate status over the previous 12 months. The USDA procedure for scoring food security

level was used to assess participant's food security status. The number of affirmative answers were counted, and the total formed the participants' score. The total scores were classified and defined as following: 0 = high food security - no food access difficulties; 1-2 = marginal food security - concern over food shortage; 3-5 = low food security - reduced quality, variety or desirability of diet); and ≥ 6 = very low food security status - disrupted and reduced eating patterns and food intake, respectively. The scores were further collapsed into two categories, with high and marginal food security forming the food secure category and low and very low food security, forming the food insecure category.[33] Along with the USDA AFSSM, the following socio-demographic characteristics were also collected: age, credit card debt, employment, ethnicity, gender, health status, housing, income, marital status, meal plan, monthly expenditure**,** number of children, physical activity levels and smoking status.

Statistical Analysis

Descriptive statistics (frequency and percentages) were used to summarize demographic characteristics and prevalence of food insecurity of the sampled students. Chi square tests, *t* tests and linear-by linear association were used to analyze the differences between food secure and food insecure students. Variables that were found to be statistically significant in the Chi square tests and *t* tests were included in multivariate logistic regression to further examine the effects of different variables on food insecurity, controlling for income, gender, age, and having children. The variables that were included in the multivariate model include ethnicity, classification, residence, health, smoking status, gender, marital status and financial variables (yearly income, monthly living expenditure, housing, take out and entertainment). Statistical significance was specified as $P< 0.05$. All data analyses were performed using SPSS statistical software (version 23.0, 2015. Armonk, NY, USA).

RESULTS

A total of 990 undergraduate (juniors, seniors; n=610) and graduate students (n=380) completed the online survey resulting in 5.9% response rate. There was over representation of the following groups of students: female (x^2 goodness of fit =5.71, p=0.017, White (x^2 goodness of fit = 50.72, p=0.000), full time (x^2 goodness of fit = 232.7, p=0.000) and graduate (x^2 goodness of fit = 46.7, p=0.000). The participants had an average age of 24.8 years and 67.9% were female.

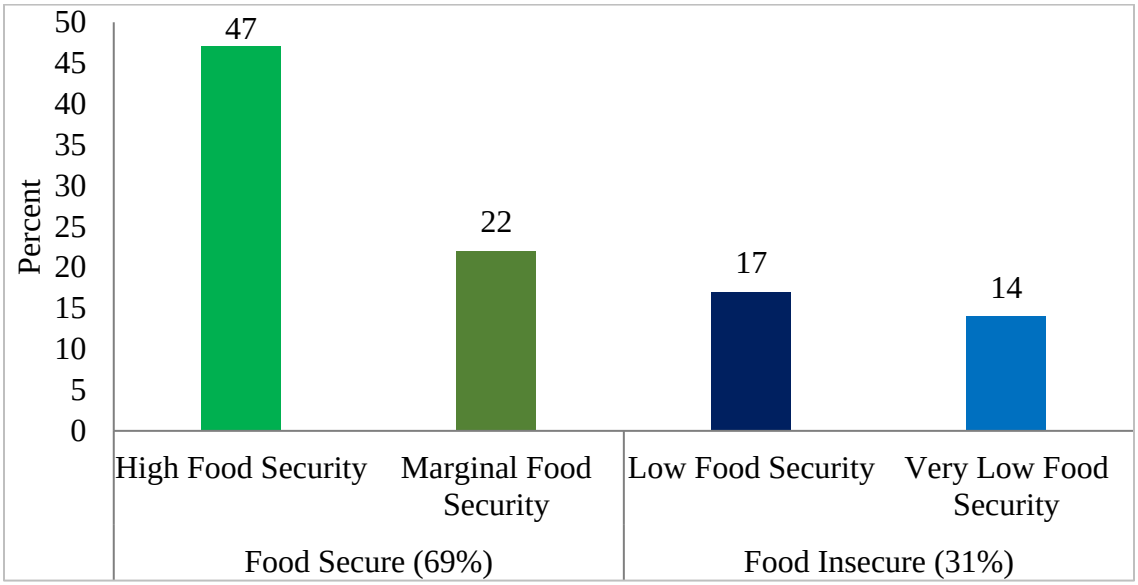

Figure 1. Classification and Prevalence of Students Food Security Status

The prevalence of food insecurity among students surveyed was 31%, with 14% having very low food security status (Figure 1). Age, marital status, residence, ethnicity, enrollment status, classification, having a meal plan, smoking status and general health were significantly different between food secure and food insecure classifications (Table 1). However, gender, having children, state/country of origin, number of days per week engaged in moderate physical activity, work for pay and number of work hours per week did not significantly differ between the food secure and insecure students. The number of students participating in food assistance programs, WIC and SNAP (Special supplemental nutrition program for women, infants and

children and supplemental nutrition assistance program, respectively) were very few (WIC n=5 and SNAP n=13) despite approximately 3 in 10 of the sampled students being food insecure.

Table 1. Demographic Characteristics by Food Security Status

Variable	Food insecure (%)	Food secure (%)	P value
Gender			
Male (n=305)	37	63	0.53
Female (n=636)	30	70	
Age			
19-25 (n=729)	34	66	0.00
≥26 (n=256)	21	79	
Marital Status			
Single (n=756)	31	69	
Married (n=174)	16	84	0.00
Divorced/Separated (n=16)	31	69	
Residence			
Off campus with roommate (n=536)	34	66	
On campus alone (n=192)	15	85	
Off campus with spouse (n=164)	42	58	0.00
Off campus with relative (n=48)	31	69	
On campus with roommate (n=45)	0[b]		
Children			
No children (n=887)	31	69	0.44
Has children (n=98)	28	72	
Ethnicity			
White (n=790)	28	72	
Hispanic/Latino (n=28)	36	64	
African American (n=65)	57	43	0.00
Asian (n=62)	26	74	
Pacific Islander (n=2)	50	50	
Native American (n=30)	50	50	
Other (n=9)	44	56	
Enrollment Status			
Full time (n=874)	32	68	
Part time (n=101)	24	76	0.02
Other (n=11)	0	100	
Classification			
Undergraduate (n=606)	36	64	0.00
Graduate (n=380)	23	77	
Meal plan			
No (n=454)	26	74	0.00
Yes (n=533)	36	64	

Table 1. Demographic Characteristics by Food Security Status (continued)			
Variable	**Food insecure (%)**	**Food secure (%)**	**P value**
State/Country of Origin			
Alabama (n=426)	32	68	0.45
Other US State (n=459)	31	69	
Other Country (n=101)	26	74	
General Health			
Very good (n=228)	15	85	0.00
Good (n=501)	32	68	
Fair (n=157)	48	52	
Bad (n=16)	69	31	
Smoking Status			
Don't smoke (n=744)	31	69	0.00
Smoke 1-5 sticks/day (n=137)	27	73	
Smoke 6-11 sticks/day (n=8)	100	0	
Smoke 11-20 sticks/day (n=6)	33	67	
Moderate Physical Activity (days/week)			
0-3 (n=403)	33	67	0.05
4-7 (n=312)	36	74	
Daily (n=186)	34	66	
Work for Pay			
No (n=312)	22	78	0.34
Yes (n=585)	24	76	
Work Hours per Week			
≤ 10 (n=122)	28	72	0.12
11-20 (n=220)	34	66	
21-30 (n=47)	36	64	
≥ 31 (n=135)	21	79	
Participation in Food Assistance Programs			
[1]WIC (n=5)	20	80	
[2]SNAP (n=13)	15	85	

The amount of yearly income, credit card debt, monthly living expenditure, housing, take-out and entertainment differed significantly by food security status. Majority (68%) of food insecure students had yearly income of < $ 10,000 and reported having credit card debts at a higher percentage (37%) than the food secure students (24%). The amount spent monthly on cell phone bill, groceries, transportation, travelling, and one-time large expense in the last one year

for example buying books and/or laptop did not significantly differ by food security status (Table 2).

Table 2. Distribution of Income, Debt and Spending Variables ($) by Food Security Status

Variable	Food Secure (n=683) %	Food Insecure (n=307) %	P value*
Yearly Income			
< $ 10,000	53	68	
$ 10,000-19,000	22	20	0.00
$20,000-39,000	11	9	
≥40,000	14	3	
Credit Card Debt			
No	76	63	
Yes	24	37	0.00
Average Monthly Living Expenditure			
$0-500	12	17	
$501-750	23	26	
$751-1,000	29	31	0.00
$1,001-1500	16	17	
>$1,500	20	9	
Housing			
$0-500	79	66	
$501-750	14	28	0.00
$751-1,000	7	6	
>$1,000	0	0	
Groceries			
$0-50	51	56	
$51-100	22	24	
$101-150	1	0	0.05
$151-200	0	0	
> $200	26	19	
Take-out			
$0-50	55	64	
$51-100	32	27	
$101-150	0	0	0.05
$151-200	0	0	
> $200	13	8	
Entertainment			
$0-50	75	82	
$51-100	20	16	
$101-150	0	0	0.02
$151-200	5	2	
> $200	0	0	

Table 2. Distribution of Income, Debt and Spending Variables ($) by Food Security Status (continued)			
	Food Secure (n=683)	Food Insecure (n=307)	
Variable	%	%	P value*
Cell Phone Bill			
$0-30	70	71	
$31-60	23	22	
$61-90	7	8	0.39
$91-120	0	0	
> $120	0	0	
Transportation			
$0-50	67	71	
$51-100	29	24	0.45
$101-150	1	0	
$151-200	0	0	
> $200	4	4	
Travelling			
$0-350	80	82	
$351-500	12	13	
$501-750	5	4	0.24
$751-1000	0	0	
> $1000	3	1	
One-time large expense in the past 1 year (e.g. laptop)			
$0-350	82	51	
$351-500	8	8	
$501-750	7	33	0.25
$751-1,000	1	2	
> $1000	2	6	
Books			
$0-350	73	68	
$351-500	17	19	0.30
$501-750	8	10	
$751-1000	0	1	
> $1,000	2	2	

Multivariate logistic regression analysis indicate that African American students were more likely to be food insecure (OR, 1.26, 95% CI, 0.27-5.86; Table 4) than students from other races/ethnicities. Students living on campus alone and those living off-campus with relatives were also more likely to be food insecure (OR 1.83 and 1.71, respectively; Table 4). Students who reported smoking 1-5 sticks and 6-11 ciggerates per day had higher odds of being food

insecure (OR 1.67 and 2.26, respectively; Table 4). Additionally, the percentage of yearly income, % of money spent on housing and entertainment were significant predictors of food insecurity (OR 1.47, 0.61 and 1.53, respectively; Table 3).

Table 3. Multivariate Logistic Model Predicting Likelihood of Being Food Insecure by Demographic Characteristics

Outcome Variable	β	OR	95% CI	P Value
Intercept	-18.933			0.000
	Ethnicity			
White/Caucasian	-0.964	0.381	0.090,1.625	0.19
Hispanic/Latino	-0.034	0.966	0.179, 5.212	0.97
African American	0.230	1.258	0.270, 5.857	0.77
Asian	-0.961	0.382	0.080, 1.837	0.23
Pacific Islander	0[a]			
Native American	-0.105	0.900	0.176, 4.598	0.90
Other	0[b]			
	Classification			
Undergraduate	0.452	1.572	0.881, 2.802	0.13
Graduate	0[b]			
	Residence			
Off campus with roommate	0.337	1.401	0.641,3.062	0.40
On campus alone	0.602	1.826	0.787, 4.235	0.16
Off campus with spouse	0.190	1.209	0.328, 4.460	0.78
Off campus with relative	0.537	1.710	0.597, 4.898	0.32
On campus with roommate	0[b]			
	General Health			
Very good	0.019	1.020	0.277, 3.751	0.98
Good	0.019	1.019	0.282, 3.676	0.98
Fair	0.140	1.150	0.307, 4.312	0.84
Bad	0[b]			
	Smoking Status			
Don't smoke	0.248	1.281	0.211, 7.780	0.79
Smoke 1-5 sticks/day	0.510	1.666	0.265,10.473	0.59
Smoke 6-11 sticks/day	0.814	2.256	0.208, 24.504	0.50
Smoke 11-20 sticks/day	0[a]			
	Financial Variables			
Average monthly living expenditure	0.713	1.189	0.973, 1.454	0.09
Housing	-0.502	0.606	0.432, 0.848	0.00
Take out	0.057	1.058	0.889, 1.261	0.53
Entertainment	0.426	1.531	1.052, 2.219	0.03

Table 3. Multivariate Logistic Model Predicting Likelihood of Being Food Insecure by Demographic Characteristics (continued)				
Outcome Variable	β	OR	95% CI	P Value
Intercept	-18.933			0.000
	Gender			
Male	0.213	1.238	0.901, 1.701	0.19
Female	0[b]			
	Marital Status			
Single	0.399	1.491	0.357, 6.229	0.58
Married	-0.338	0.713	0.129, 3.938	0.70
Divorced/separated	0[b]			
	Children			
No	-0.396	0.673	0.349, 1.297	0.24
Yes	0[b]			

Majority of students (60%) reported receiving food from a friend or relative when they do not have enough money to acquire food. A very low percentage of students reported seeking assistance from food pantry/bank and soup kitchens (3 and 1%, respectively). Ten percent reported hunting, gardening or fishing to acquire food when they cannot afford to purchase it (Table 4).

Table 4. Resources Utilized by Students' to Cope with Food Insecurity (n = 486)	
Variable	**n (%)**
Food pantry/bank	17 (2.92)
Soup kitchen	5 (0.86)
Go through dumpster	2 (0.34)
Hunting/gardening/fishing	58 (9.97)
Receiving food from friend or relative	349 (59.97)
Other (attend events with free food, free meals at church, borrow money, coupons)	55 (9.45)

DISCUSSION

This study investigated the prevalence and identified factors associated with food insecurity in a sample of students attending a public university in southeast US. Literature indicates this is the fourth study to evaluate FI among college students in this region.

One of the universities is located in the same state and had a lower prevalence of food insecurity (14 compared to our 31%)[9] whereas the other two (located in different states but the same southeast region of the US) had higher prevalence than our study 36.6% and 56.2%.[30,31]

Similar studies spanning across the rest of the US indicate that prevalence of food insecurity among college students range from 12 to 67% [3–5,9,19–21,30,34] which is higher than that of the general US population.[1] These findings provide empirical evidence that food insecurity is a salient issue among college students and there is need for the federal government to revise policy on SNAP eligibility criteria for college students and establish safety nets like the National School Lunch Program.[35]

In the current study, race was significantly (P=0.000) associated with food insecurity. The African American students group had higher odds of being food insecure when compared to students from other races/ethnicities after adjusting for age, gender, having children and income. Similar findings have been reported in other studies; African American students were more likely to have very low food security compared to White students.[5,6,29] These findings are comparable to the national data on food insecurity which report that African Americans have the highest risk for food insecurity[1] compared to other race groups within the US. The correlation between African Americans and food insecurity are likely to be contributed by socioeconomic factors such as poverty and unemployment, elements that are documented in this race group.[1,36,37]

In the present study, students living on campus alone or living off campus with relatives were at a higher risk of being food insecure. Our findings correspond partly to studies that found that living off-campus increased risk of food insecurity,[3,30] but conflict with results of other studies that found that students living off campus with their parents or relatives were less likely

to be food insecure.[3,5] The role of parents or guardians in assisting students with food and living expenses need to be explored to clarify this relationship. While this study did not investigate housing insecurity, it is important to note that other studies have reported the high incidence of housing and food are co-insecurities among college students.[4,8,34,38] The salient issues of housing and food insecurity among college students warrant further investigation if effective interventions were to be implemented to alleviate these problems.

Spending on cell phone bill, transportation, travelling and school supplies (books, laptops) were not significantly different between food secure and food insecure students. The lack of variation in these spending variables may be partially explained by the difficulty in determining accurate spending by students. There is a possibility that some students may have under-reported or over-reported the amount they spent on various items because they were relying on their memory for some non-recurring bills or variable bills like school supplies. The fact that there were more food insecure students (37%) with credit card debt compared to food secure students (24%) is consistent with past studies that have established that students increasingly utilize credit cards and accrue huge debts during their college years.[39,40]

To the best of our knowledge, this is the first study to investigate association of smoking status with food insecurity in college students. A significant (p=0.000) association between food insecurity and smoking was identified in our study; students who smoked 6-11 cigarettes a day had increased risks for food insecurity (OR, 2.256; 95% CI 0.208, 24.504) compared to those who smoked less (1-5 cigarette per day; OR, 1.666; CI 0.265, 10.473) or students who did not smoke (OR, 1.281; CI 0.211, 7.780). Similar to our results, a previous study conducted among low income families found that the prevalence of smoking was higher among poor food insecure families compared to poor food secure families.[24] Available research has not explored the

relationship between smoking and food insecurity sufficiently but a simple relationship maybe either money spent buying cigarettes reduce what is available to purchase food or smoking is a coping mechanism for escaping stress related to food insecurity.[41]

The number of students utilizing food assistance programs such as food pantries/bank (2.9%; n=486), soup kitchens (1%; n=486), supplemental nutrition assistance program (SNAP) (1.3%; n=990) and supplemental nutrition program for women infants and children (WIC) (0.5%; n=990) were very low. There may be a number of reasons why this is so, 1) it could be due to lack of resource awareness, 2) stigma associated with receiving handouts or 3) the fact that students are not eligible for programs such as SNAP.[7,42,43] In this study, students displayed several coping strategies to acquire food. Notable among the strategies include fishing, gardening and hunting which although seasonal in nature, they play a role in supplementing individuals food supply.[44] In a study conducted in Canada, gardening was found to be an important contributor to household food security.[45]

The findings of this study highlight the existence of food insecurity among college students attending a public university in southeast US. This study also shows the factors associated with food insecurity (living on campus alone, living off-campus with a relative, race/ethnicity, smoking and credit card debt) and resources utilized by food insecure students as they cope with lack of resources for food. These findings were presented to the university administrators and researchers, and the data is in the process of being utilized to plan for institutional response and intervention targeting affected students.

LIMITATIONS

There are several limitations in this study that must be noted. First, the cross-sectional study design is prone to non-response bias if participants who chose to participate in the study

differ from those who do not participate.[46] Second, all items of the survey were self-reported and therefore, there might have been some response biases. Additionally, although we used the validated USDA AFSSM in this study, this instrument does not collect specific information on food security of children, for example number of times a child skipped meals or cut the size of meals because there wasn't enough money to purchase food, and the number of times this happened. There is need to develop a validated assessment instrument to measure food security status among college students.

CONCLUSIONS

Food insecurity is a critical issue for one third of students surveyed in this study. Living on campus alone, smoking 6-11 cigarettes a day and % of money spent on housing and entertainment were significant predictors of food insecurity. Although the exact direction of the relationship between smoking and food insecurity was not established in this study, it is important to explore this topic further and appropriate interventions put in place to reduce smoking among college students. This study did not ascertain if debt accruing behavior by college students was prompted by food insecurity or a lack of financial management skills. Assuming the behavior was caused by lack of financial resources, it would be necessary to initiate policy responses by modifying and/or increasing access to grants, loans and other support programs by students, whereas if behavior was caused by lack of financial management skills, then trainings on financial and food resource management are warranted. Further studies are needed to gain deep insights into the experiences of food insecure students, qualitative studies that include in-depth interviews and focus group discussions are therefore necessary.

FUNDING

This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.

CONFLICT OF INTEREST

The authors declare no conflict of interest in preparing this article.

ACKNOWLEDGEMENT

The authors would like to thank the University's registrars' office for sending the study survey to students via email.

REFERENCES

1. Coleman-Jensen A, Rabbitt MP, Gregory CA, Singh A. Household Food Security in the United States in 2016. 2017. https://www.ers.usda.gov/webdocs/publications/84973/err-237.pdf?v=42979. Accessed March 2, 2018.
2. Bruening M, Argo K, Payne-Sturges D, Laska MN. The Struggle Is Real: A Systematic Review of Food Insecurity on Postsecondary Education Campuses. *J Acad Nutr Diet*. 2017;117(11):1767-1791.
3. Chaparro MP, Zaghloul SS, Holck P DJ. Food insecurity prevalence among college students at the University of Hawai'i at Manoa. Public health nutrition. *Public Health Nutr*. 2009;12(11):2097-2013.
4. Freudenberg N, Manzo L, Jones H, Kwan A, Tsui E, Gagnon M. Food Insecurity at CUNY: Results from a Survey of CUNY Undergraduate Students A Report from: The Campaign for a Healthy CUNY. 2011. https://www.gc.cuny.edu/CUNY_GC/media/CUNY-Graduate-Center/PDF/Centers/Center for Human Environments/cunyfoodinsecurity.pdf. Accessed January 24, 2018.
5. Morris LM, Smith S, Davis J, Null DB. The Prevalence of Food Security and Insecurity Among Illinois University Students. *J Nutr Educ Behav*. 2016;48(6):376-382.e1.
6. Maroto ME, Snelling A, Linck H. Food Insecurity Among Community College Students: Prevalence and Association With Grade Point Average. *Community Coll J Res Pract*. 2015;39(6):515-526.
7. Hughes R, Serebryanikova I, Donaldson K, Leveritt M. Student food insecurity: The skeleton in the university closet. *Nutr Diet*. 2011;68(1):27-32.
8. Goldrick-Rab S, Broton K, Eisenberg D. The Challenge: Food and Housing Insecurity

Among Undergraduates. http://wihopelab.com/publications/Wisconsin_hope_lab_hungry_to_learn.pdf. Accessed January 25, 2018.

9. Gaines A, Robb CA, Knol LL, Sickler S. Examining the role of financial factors, resources and skills in predicting food security status among college students. *Int J Consum Stud*. 2014;38(4):374-384.
10. Seligman HK, Laraia BA, Kushel MB. Food insecurity is associated with chronic disease among low-income NHANES participants. *J Nutr*. 2010;140(2):304-310.
11. Farahbakhsh J, Hanbazaza M, Ball GDC, Farmer AP, Maximova K, Willows ND. Food insecure student clients of a university-based food bank have compromised health, dietary intake and academic quality. *Nutr Diet*. 2017;74(1):67-73.
12. Ramsey R, Giskes K, Turrell G, nutrition DG-P health, 2012 undefined. Food insecurity among adults residing in disadvantaged urban areas: potential health and dietary consequences. *Public Health Nutr*. 2012;15(2):227-237.
13. Bruening M, Brennhofer S, van Woerden I, Todd M, Laska M. Factors Related to the High Rates of Food Insecurity among Diverse, Urban College Freshmen. *J Acad Nutr Diet*. 2016;116(9):1450-1457.
14. Bruening M, van Woerden I, Todd M, Laska MN. Hungry to learn: the prevalence and effects of food insecurity on health behaviors and outcomes over time among a diverse sample of university freshmen. *Int J Behav Nutr Phys Act*. 2018;15(1):9.
15. Mukigi D, Thornton K, Binion A, et al. Food Insecurity among College Students: An Exploratory Study. *J Nutr Heal Sci J Nutr Heal Sci*. 2018;5(1).
16. Mirabitur E, Peterson KE, Rathz C, Matlen S, Kasper N. Predictors of college-student

food security and fruit and vegetable intake differ by housing type. *J Am Coll Heal*. 2016;64(7):555-564.

17. Mi-Ting K, Peters Jr RJ, Ford K, Meshack A, Hill M. The Relationship Between Perceived Psychological Distress, Behavioral Indicators and African American Female College Students Food Insecurity. *Am J Health Stud*. 2013;28(3):127-133.
18. Crutchfield R, Clark K, Gamez S, Green A, Munson D, Stribling H. *Serving Displaced and Food Insecure Students in the CSU*. Long Beach, CA; 2016. http://food.ucsb.edu/docs/default-source/default-document-library/csu-report-january-2016---displaced-and-food-insecure-students.pdf?sfvrsn=1eaf4669_0. Accessed May 3, 2018.
19. Luke Wood BJ, Harris Iii F, Delgado NR. *Struggling to Survive – Striving to Succeed: Food and Housing Insecurities in the Community College*.; 2017. https://www.luminafoundation.org/files/resources/food-and-housing-report.pdf. Accessed April 30, 2018.
20. Patton-López MM, López-Cevallos DF, Cancel-Tirado DI, Vazquez L. Prevalence and Correlates of Food Insecurity Among Students Attending a Midsize Rural University in Oregon. *J Nutr Educ Behav*. 2014;46(3):209-214.
21. Martinez SM, Webb K, Frongillo EA, Ritchie LD. Food insecurity in California's public university system: What are the risk factors? *J Hunger Environ Nutr*. 2018;13(1):1-18.
22. Duffy PA, Zizza CA, Duffy PA, Zizza CA. Food Insecurity and Programs to Alleviate it: What We know and What We are Yet to Learn. *J Agric Appl Econ*. 2016;48(01):1-28.
23. Kim J, disease JT-P chronic, 2016 undefined. Cigarette Smoking Among Socioeconomically Disadvantaged Young Adults in Association With Food Insecurity and

Other Factors. *Prev Chronic Dis*. 2016;13.

24. Armour BS, Pitts MM, Lee C-W. Cigarette Smoking and Food Insecurity among Low-Income Families in the United States, 2001. *Am J Heal Promot*. 2008;22(6):386-390.
25. Pia Chaparro M, Zaghloul SS, Holck P, Dobbs J. Food insecurity prevalence among college students at the University of Hawai'i at Mānoa. *Public Health Nutr*. 2009;12(11):2097-2103.
26. Berkowitz SA, Seligman HK, Choudhry NK. Treat or Eat: Food Insecurity, Cost-related Medication Underuse, and Unmet Needs. *Am J Med*. 2014;127(4):303-310.e3.
27. Supplemental Nutrition Assistance Program (SNAP). 2017. https://www.fns.usda.gov/snap/facts-about-snap. Accessed May 7, 2018.
28. Members – College and University Food Bank Alliance. https://sites.temple.edu/cufba/members/. Accessed March 5, 2018.
29. Payne-Sturges DC, Tjaden A, Caldeira KM, Vincent KB, Arria AM. Student Hunger on Campus: Food Insecurity Among College Students and Implications for Academic Institutions. *Am J Heal Promot*. 2018;32(2):349-354.
30. Hagedorn R, Olfert M. Food Insecurity and Behavioral Characteristics for Academic Success in Young Adults Attending an Appalachian University. *Nutrients*. 2018;10(3):361.
31. McArthur L, Ball L, Danek A, education DH-J of nutrition, 2017 undefined. A High Prevalence of Food Insecurity Among University Students in Appalachia Reflects a Need for Educational Interventions and Policy Advocacy. *J Nutr Educ Behav*. 2017.
32. Pourhoseingholi MA, Vahedi M, Rahimzadeh M. Sample size calculation in medical studies. *Gastroenterol Hepatol from bed to bench*. 2013;6(1):14-17.

33. USDA ERS - Survey Tools. https://www.ers.usda.gov/topics/food-nutrition-assistance/food-security-in-the-us/survey-tools/. Accessed May 2, 2018.

34. Goldrick-Rab S, Richardson J, Hernandez A. *Hungry and Homeless in College:Results from a National Study of Basic Needs Insecurity in Higher Education*. Madison, WI; 2017. http://wihopelab.com/publications/hungry-and-homeless-in-college-report.pdf. Accessed April 30, 2018.

35. USDA ERS - National School Lunch Program. https://www.ers.usda.gov/topics/food-nutrition-assistance/child-nutrition-programs/national-school-lunch-program.aspx. Accessed May 14, 2018.

36. Weinfield NS, Mills WG, Institute U, et al. Hunger in America 2014 National Report Prepared for Feeding America. 2014. http://help.feedingamerica.org/HungerInAmerica/hunger-in-america-2014-full-report.pdf. Accessed January 25, 2018.

37. African American Hunger Facts. 2017. http://www.feedingamerica.org/assets/pdfs/fact-sheets/african-american-hunger-fact-sheet.pdf. Accessed May 14, 2018.

38. Tsui E, Freudenberg N, Manzo L, Jones H, Kwan A, Gagnon M. *Housing Instability at CUNY: Results from a Survey of CUNY Undergraduate Students A Report from: The Campaign for a Healthy CUNY*.; 2011. https://www.gc.cuny.edu/CUNY_GC/media/CUNY-Graduate-Center/PDF/Centers/Center for Human Environments/cunyhousinginstability.pdf. Accessed March 13, 2018.

39. Norvilitis JM, Szablicki PB, Wilson SD. Factors Influencing Levels of Credit-Card Debt in College Students1. *J Appl Soc Psychol*. 2003;33(5):935-947.

40. Norvilitis JM, Merwin MM, Osberg TM, Roehling P V., Young P, Kamas MM.

Personality Factors, Money Attitudes, Financial Knowledge, and Credit-Card Debt in College Students. *J Appl Soc Psychol*. 2006;36(6):1395-1413.

41. Ding M, Wilson N. Undiagnosed prediabetes among food insecure adults. *Am J Health Behav*. 2014;38(2):225-233.
42. Students | Food and Nutrition Service. https://www.fns.usda.gov/snap/students. Accessed May 1, 2018.
43. King J. Food Insecurity Among College Students-Exploring the Predictors of Food Assistance Resource Use. 2017. http://rave.ohiolink.edu/etdc/view?acc_num=kent1492466215893925. Accessed January 25, 2018.
44. Skinner K, Hanning R, nutrition LT-P health, 2014 undefined. Prevalence and severity of household food insecurity of First Nations people living in an on-reserve, sub-Arctic community within the Mushkegowuk Territory. *Public Health Nutr*. 2014;17(1):31-39.
45. Kortright R, Wakefield S. Edible backyards: a qualitative study of household food growing and its contributions to food security. *Agric Human Values*. 2011;28(1):39-53.
46. Davern M. Nonresponse Rates are a Problematic Indicator of Nonresponse Bias in Survey Research. *Health Serv Res*. 2013;48(3):905-912.

V. MANUSCRIPT 3

FOOD INSECURITY AMONG COLLEGE STUDENTS: AN EXPLORATORY STUDY

Article Published in the Journal of Nutrition and Health Sciences

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ABSTRACT

College students are characteristically vulnerable to food insecurity because of the increase in the cost of higher education. Students face competing budget demands that may compromise food dollar allocation. This study explored the experiences of 17 food insecure college students using semi-structured interviews. Analysis of audiotaped interview data was performed using emergent theme analysis. The participants narrated their experiences with food insecurity, how it affects them and how they cope with food insecurity. Specific themes included: (1) history of food insecurity; (2) competing financial demands; (3) coping with food insecurity; (4) effects of food insecurity on academics; (5) effects of food insecurity on health; and (6) role of support systems. Food insecurity is a salient issue among college students and it can have a negative impact on student academic success and health. University communities should respond by identifying affected students, establishing support systems such as food pantries and creating campus awareness of the issue.

Key Words: College students; Food insecurity; Coping strategies; Interview.

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INTRODUCTION

The United States Department of Agriculture (USDA) defines food insecurity as "a household-level economic and social condition of limited or uncertain access to adequate food" [1]. Reports from the 2016 Current Population Survey indicate that 12.3% of United States (US) households are food insecure [2]. Recent studies have been conducted regarding food insecurity on college campuses and available literature estimate that 12 to 59% of college students experience some level of food insecurity [3-9]. The Hunger in America 2014 National Report prepared for Feeding America indicates that 10% of their 46.5 million clients were currently students in higher education [10]. These data support the idea that hunger and food insecurity are prevalent on college campuses. However, there is lack of quantitative study that explore the effects of food insecurity on daily lives of college students.

It is projected that by the year 2020, 65% of all jobs in the US economy will require postsecondary education [11]. It is estimated that there are approximately 19 million students attending institutions of higher learning [12]. Attending college and earning a degree is perceived as an essential step to ensure success in life [11] and therefore, this perception may have significantly contributed to the increase of enrollment of typically underrepresented populations such as first-generation college attendees and students from low socioeconomic backgrounds [5-13].

Results from multiple studies indicate that food insecurity have negative impacts on the grade point average (GPA) of college students [4-9]. One study has indicated that food insecurity is associated with adult cognitive impairment and academic hiatus [15]. This provides an insight into the potential negative impacts of food insecurity on students' educational success.

College students are often referred to as emerging adults that encounter life-changing experiences as they transition to life away from home [16]. These experiences may bring about stress among students as they try to adapt to life away from home. Food insecurity has been identified by a recent study as an important cause of stress among college students [13] and it may contribute to undesirable eating habits in this population. Stress has also been associated with eating disorders such as binge eating and meal restriction [17]. Whether eating disorders are associated with food insecurity among college students is unknown.

Food insecurity negatively affects dietary intake, for example, it is associated with intake of energy dense foods and the lack of diet variation [18]. In a study that was conducted to establish the relationship of college student food security and fruit and vegetable intake, a significant decrease in the intake of fruits and vegetables were associated with increased severity of food insecurity in college students who resided in housing where meals were not provided [19]. Dietary patterns established during college years are likely to be continued throughout life [20]. Therefore, it is important for researchers to develop interventions to teach and encourage healthy eating on a value menu.

Past studies investigating food insecurity among college students have mostly used quantitative methods to present demographic characteristics and prevalence of food insecurity among sampled students [3-9]. Consequently, little is known about the daily experiences, coping mechanisms and consequences of food insecurity among college students.

The objectives of our study were to investigate the lived experiences of food insecure college students in a southern public institution and bring awareness on what happens when college students cope with food insecurity.

METHODS

This qualitative study used individual interviews to explore the experience of food insecurity among college students enrolled at a public university in southeast United States. Participants were recruited using flyers posted on notice boards throughout campus. Students who were struggling to make ends meet and having disrupted eating patterns, reduced food intake, and reduced food quality due to lack of financial resources were eligible to participate. Interested students responded to the flyer (Appendix B) via email and the researchers scheduled the interview appointments at the convenient time for both parties. All participants provided written informed consent before being interviewed and were offered a $20.00 grocery store gift certificate after study participation. Study approval was provided by the Southeastern University Institutional Review Board (IRB).

Participants completed one semi-structured in person interview that lasted between 30-45 minutes. A set of two trained student researchers conducted the interviews using an interview guide shown in Appendix D. The interviews were conducted privately in a closed office. Interviewers reassured the participants of the confidentiality of the information that they will share and encouraged them to speak freely about their experiences with food insecurity. All interviews were audio recorded using an audio recorder and were transcribed verbatim by the student researchers.

The interview data were reviewed using qualitative software, Atlas.ti (Berlin, Germany). The researchers coded the data into themes and sub-themes. The codebook was developed by a graduate student researcher after extensive familiarization with the data. The researchers read and re-read the transcripts extensively using the constant comparative technique of the grounded theory [21]. To methodically understand the participants experiences, coding and analysis were

conducted concurrently [22, 23]. We reached theoretical data saturation [21] with 14 individual interviews, but we continued with the interviews to ensure no new themes emerged in the next few interviews. We reached data repetitiveness and informational redundancy at 17 interviews. To check for inter-analyst agreement, two researchers who were unfamiliar with the coding scheme were trained using quotations from the sample. After the training, the two researchers separately coded one randomly selected transcript. The inter-analyst agreement was 87% and met the established standard for agreement [24].

RESULTS

During the study period (January to February 2017), 19 students responded to the recruitment flyers. Of the 19 students, 2 were screened out because they did not meet eligibility criteria as determined by the screening questions that were asked before the start of the semi-structured interview. The participants were asked if they were struggling financially, having disrupted eating patterns, reduced food intake and/or reduced quality of food and if they answered yes to these questions, they were found to be eligible to participate in the study. Most of the participants were female (71%), and slightly more than half of the participants were Caucasian. Sixty five percent of the participants were undergraduates and 35% were graduate students. Two participants were non-traditional students, one was married, and each had a child. Table 1 provides a further breakdown of the study's participants.

Table 1. Participant Characteristics (n=17)

Characteristic	n (%)
Age	
20-30	14 (82)
31-40	1 (6)
41-50	1 (6)
≥ 51	1 (6)

Table 1. Participant Characteristics (n=17) (continued)	
Sex	
Female	12 (71)
Male	5 (29)
Marital Status	
Single	16 (94)
Married	1 (6)
Children	
No	15 (88)
Yes	2 (12)
Race/ethnicity	
African American	2 (12)
Asian	5 (29)
Caucasian	9 (53)
Latina/Hispanic	1 (6)
Place of Birth	
USA	14 (82)
Another country	3 (18)
Classification	
Undergraduate	11 (65)
Graduate	6 (35)

After data analysis, we identified the following specific themes: (1) history of food insecurity; (2) competing financial demands; (3) coping with food insecurity; (4) effects of food insecurity on academics; (5) effects of food insecurity on health; and (6) role of support systems. The themes, sub-themes and illustrative quotations are listed in Table 2.

Table 2. Themes, Sub-themes and Quotations of the Experiences of Food Insecure Students		
Theme	**Sub-theme**	**Illustrative Quotation**
History of food insecurity	Early childhood	*When I was a child that's the economy was not good, so we tried to save money and hmm just eat the cheapest, cheapest foods.*
	Transition to college	*Oh no, it's definitely started with college.*
Competing financial demands	Fixed bills	*First, we need to pay our bills somehow, you know. So, I mean the light bill and the water bill and the cable… and those things. And then from what is left, we kind of plan you know, the food budget.*
Competing financial demands	Unexpected expenditure	*Things happen, car breaks down, all these other financial things cut into your food*

		budget, and there's nothing you can do about it because you must take care of it but its stressful and that's been my experience as a student.
Coping with food insecurity	Employment	*I ended up getting a job second and being able to supplement that a little bit with still not being able to work a whole lot because of classes*
	Fixed bills	*First, we need to pay our bills somehow, you know. So, I mean the light bill and the water bill and the cable… and those things.*
	Planning for food	*It's more at the beginning of the month I don't plan that much. Towards, the middle of the month I start planning.*
	Shopping habits	*So, what I've started recently, is to try and find deals before I go to the grocery store.* *I work from the back to the front. And so, I start, and I get the eggs, and then...if it's in the budget for it then I get the almond milk. And then I work forward..... Um...then I just work my way, I get couscous or quinoa or whatever they have that's cheapest. And then get the vegetables. And then if I'm totaling it up in my cart and it's going to cost more than I can afford, I do like a loop back and put stuff back that I don't think is going to be a necessity for that week.*
	Quality of diet	*For a while it was Ramen noodles and crackers.*
	Quantity of food	*I'll just kind of cut the meals and make them smaller or skip lunch or skip dinner, that kind of thing.*
Effects of food insecurity on health	Mental health	*It's depressing, very depressing. Ahhh, I find myself struggling. Am I going to eat today? Am I going to study today?*
	Physical health	*If I don't eat enough, I don't feel good, and I will stay in bed all day long, and I hate to stay in bed all day long.*
	Social health	

		When I'm hungry, I'm hungry and that can be over whelming, and your body is telling you, you need to do something about it. The main thing is I just get really irritable. I feel bad because I know logically you're taking things out on other people and at that point I'm like you need to take a break from people until you get food in your system.
Role of support systems	Asking for help from family or friends	*I'm very independent so I don't like to ask for help or to ask for especially like for money or stuff like that.* *I borrowed some of my roommates' food, took them up on their offer to buy me food a couple of times.*
	Food pantry	*I volunteered at, um, the community market and seeing the people that were there, even though it was actually at that time that I was struggling, like, the most, I still didn't feel like I deserved it like they did.*

History of food insecurity

Some participants discussed how food insecurity or lack of food was not a new experience to them. Most of the participants discussed how they remember not having enough food when they were children, how their families struggled to put food on the table and some talked about how they became food insecure when they joined college:

Early years: *I can't say it a new experience. I have dealt with it growing up. I have dealt with it in my adulthood, I have dealt with on many occasions and it becomes almost second nature to me.*

Growing up there was some food items I wanted, and we couldn't afford. I wanted healthy food growing up, I wanted fresh fruits and vegetables. I wanted healthy fats.

Transition to college: *Um but not having enough food or really like that falling onto me was a new experience.*

Oh no, it's definitely started with college.

Competing financial demands

The participants talked about how expenditures such as water and medical bills, and other unexpected expenses reduced their food dollar allocation. The participant's prioritized other expenses over food and money that was left was used for food:

Fixed bills: *First, we need to pay our bills somehow, you know. So, I mean the light bill and the water bill and the cable… and those things. And then from what is left, we kind of plan you know, the food budget*

Unexpected expenditure: Some participants reported unexpected expenses coming up and further straining their limited resources:

Yes! Um, things come up, you know, when the sole comes off your tennis shoes and you planned to wear them for another 6 months, you know, there's nothing else to do than go buy a new pair of tennis shoes.

And, so like I have to budget medical expenses stuff after that. And then whatever is left over is food.

Coping with food insecurity

Employment: Three participants reported working off campus with the aim of raising money for their upkeep:

I work two jobs, and I'm a full-time student, but one of my jobs pays bi-weekly and it's only about $100, and then the other job, I get paid once every 10 weeks and it's also about $100.

I am currently working a third shift job that I get off at 6.30 in the morning.

I work odd jobs like tutor people.

Planning for food: When the participants were asked how they planned and budgeted for their meals, it was clear from the responses that there are those who do not plan until they are almost running out of money..."It's more at the beginning of the month I don't plan that much. Towards, the middle of the month I start planning," others who weigh their options before making a decision on how they would spend their money on food...."Like trying to go to the grocery store and buy food versus eating out. That definitely is a big difference," and there are those who are careful and skillful planners... "Yeah just like really careful budgeting to make sure it would make to the end of the semester," and "Um, usually like I'll write a little like check-list on my phone, and like check the prices, and I'll be like ok well do I really need this right now?" and like if I don't I won't get it and then like I usually check in my cart like 'ok this might be a little too much', and I'll go put stuff back".

Shopping habits: When the participants were asked to discuss how they go about their grocery shopping, it was evident that majority of them made grocery lists based on the meals they have in a day:

I definitely have to make a list. On my phone, I must make a list and now I'm getting to where I'm really specific like I'll have breakfast, lunch, snack, dinner, what drinks I need and

like miscellaneous stuff I need like paper plates and those stuff.

One participant reported making a grocery list based on how the food items are organized in the store:

I'm weird, I organize my list specifically where each section is, so I don't have to go back and forth, so I don't see things, I don't need and get tempted to buy them. I literally organize my list so I can go in, grab what I need and get out, I can grab what I need and be out in half an hour.

Another participant reported that he knew exactly which isle to go to get a specific food item and how much he would spend during a grocery shopping trip:

I go to the store, I know exactly what aisle to go to and what to get and how much I'm going to spend.

When the participants were asked to discuss the steps they took during their food crisis, they discussed how they settled on consuming foods that were cheap, lacked variety and less nutritious because they could not afford healthier options.

Quality of diet: *I sometimes eat vitamins and rice and flour. That will give me energy.*

I'll buy, um, just some more unhealthy things that will last longer um, and just get by, by buying the cheap things.

I ate a lot of ramen. My ramen game was strong. I would do like ramen and siracha or ramen and eggs - I ate a lot of ramen and eggs because eggs are really cheap. Um, I ate a lot of oatmeal and grits, like to the point where I never want to look at oatmeal or grits ever again.

Although the participants wished to eat more nutritious food, the cost of the more healthier food options were prohibitive, and they did not consider the quality of food they were purchasing but the cost of it:

I can't afford the healthy option.

I don't consider nutrition, I look at the cost. Hey its cheap....can I afford this?

Most of the respondents expressed the desire to consume more fresh produce like fruits and vegetables but the cost was beyond their reach,

The hardest thing is the fresh…the fresh fruits and vegetables. You know, that's the hardest thing to get whenever you're on an extremely fixed income.

One participant had no desire to purchase fruits because they were not filling yet they were expensive:

You have grapes, bananas and things like that, they're pretty much a snack. It's not something I am going to eat and get full off them so, I can't go another 8 hours before eating. Am I going to consume that (fruits) and in 30 minutes I want something else...in an hour or so. Why waste my $3 to 5 on something and I can hold on my $3 to 5 and spend on something I can get full off.

Quantity of food: Most of the participants employed coping strategies such as cutting the size of their meals and skipping meals to ensure they have food:

I'll just kind of cut the meals and make them smaller or skip lunch or skip dinner, that kind of thing.

Making sure to only eat half of my meal anytime I ever went to eat on campus.

The participants described how hungry they were when they didn't have money to buy food and how they did not have energy to stay awake in class because they were not getting enough food:

When I actually was hungry and like couldn't just go to the store and buy something or couldn't go on campus and get something because I didn't have that money anymore it was kinda like "what do I do now?

I'm falling asleep in class because like I'm not getting enough to eat, and I'm just… not fueled I guess is what it is.

Effects food insecurity on academics

When the participants were asked how being hungry affects them as students, they talked about how their school work is negatively affected by hunger, they talked about how they would sleep in class and not focus and therefore their grades suffered in the long run.

Um there were definitely a lot of times where like I was falling asleep in class.

There are times when I'm really hungry and not able to focus on school work or whatever I'm working on.

Effects Food Insecurity on Health

From the interviews, it was apparent that food insecurity negatively affected the health of most of the participants. The participants mental, physical and social health were negatively affected by food insecurity:

Mental health: *Another thing, it affects my mood. I get angry. I have to separate myself from other people, I am not a pleasant person.*

It's depressing, very depressing. I find myself struggling, Am I gonna eat today? Am I gonna study today?

It does cause me stress.

It just makes me cranky, like you know, hangry, I guess but it makes me really crabby. I get, I get really irritated if I get hungry and I get really snappy.

Physical health: *I don't eat as much like I feel like throughout the day I'm just tired, like I'm not getting energy from my food, and so like, I'm sure that doesn't help with the focus.*

I was noticing like throughout the semester that I wasn't staying awake and I knew that was because calories.

I'm pretty athletic....that was something that was affected by like not having enough calories....so I know I can't go workout from a calorie standpoint, I can't afford that. I wish I could do this

(exercise) but I don't have enough food to sustain me to do this um so I'm gonna chose not to exercise.

Social health: *Socially it's hard. Uh, because, a lot of people they're like social things, like hey let's go out to the movies or let's go out to dinner or something and I'm like oh no***.**

So, I wasn't really able to go to events with a lot of my peers because again they all cost money.

From social standpoint, I couldn't go out to eat um definitely like whenever I was making money was saving it for food so wasn't doing anything-any of the other activities.

I didn't join any of the clubs, didn't buy any of the t-shirts, didn't do any of that stuff and just like out of necessity.

So, I wasn't really able to go to events with a lot of my peers because again they all cost money.

Role of support systems

There were mixed responses when the participants were asked if they feel comfortable asking for help/support from their parents, relatives or friends, and whether they utilize community support resources like the food pantry. Some were comfortable asking for help: "I borrowed some of my roommate's food, took them up on their offer to buy me food a couple of times," while others were not comfortable: "So, I'm not the one to like go out and ask. I mean I even feel bad asking for [food from]my parents."

Some participants reported that they were comfortable utilizing the food pantry on campus, "It doesn't bother me at all," while others felt they did not need the food pantry or deserve food assistance**:**

Oh. I don't need those, I have never used that or anything.

I was struggling, like, the most, I still didn't feel like I deserved it like they did and I didn't like want, you know, I didn't want to seek out that help.

DISCUSSION

Previous studies have provided statistics on the prevalence of food insecurity among college students, [4-9, 11, 13] but the voices of the food insecure students are absent in these studies. Consequently, very little information is known about the factors that influence food insecurity among college students, how they cope with food insecurity and how food insecurity affects their wellbeing and success as students. This study aimed at filling that gap of information using semi-structured interviews to explore the lived experiences of the food insecure college students.

The participants in this study expressed that their food insecurity was either something they have lived with since childhood or something new experienced when they joined college. These findings may be partly explained by the fact that there has been tremendous increase in college enrollment by students from low socioeconomic backgrounds and the fact that college students often termed as emerging adults often lack food preparation knowledge, skills and resources which when combined may increase their risk for food insecurity [5, 24].

Some participants in this study reported working multiple jobs to supplement their income to ensure they have financial resources to purchase food. They expressed understanding that working affected their classwork because they had less time for studying and completing projects. One past study found that in households in which the household head has multiple jobs and works different shifts have increased risk of food insecurity as compared to similarly placed households in which the head holds one full-time job. It is not clear if risk of food insecurity is due to complicated schedule or unstable income [25]. To the best of our knowledge, there has been no research that has explored the relationship between food insecurity and work hours among college students. Therefore, we recommend that future studies investigate this topic.

Students often have financial demands that compete with their food dollar. The participants talked about prioritizing fixed bills and then using the little money that is “left over” to purchase food. They also talked about unexpected expenses like medical costs and fixing a broken car. Fixed and unexpected expenses have been found to increase the risk of food insecurity [26, 27]. Additionally, the cost of books, living expenses and tuition has increased by 46% since 2001 nationwide [28]. All these factors increase the odds of an average college student becoming food insecure.

Budgeting and financial skills are important in managing limited resources. The participants in this study had various levels of these skills, for instance one participant reported that he/she only budget/plan for meals when resources dwindle, and another participant reported that he/she makes a grocery list, knows exactly how much to spend and knows exactly which isles to go to in the grocery store. Previous research focused on low income populations show that food security can be improved by optimization of food resources through skills [15]. Future studies should focus on imparting food resource management skills and knowledge among college students.

The participants often reported decreasing the quality or quantity of their meals to ensure they stretch their food resources. They reported eating cheap meals, cutting the size or skipping some meals in order to have food to eat later. These findings affirm other studies that found that food insecure individuals purchase inexpensive processed food items and decrease amounts of food eaten when resources decrease [29, 30]. One participant talked about eating very little meals even when she has adequate food because she has extreme fear of running out of food and in contrast, another one talked about binge eating when food is available. Meal restriction and binge eating behaviors have been reported in previous studies, where food insecure individuals were

found to decrease amount of food eaten when resources reduce and compensate by overeating when more food is available. These behaviors may lead to the development of eating disorders. Additionally, research has shown positive associations between food insecurity and eating disorders [17].

In the present research, food insecurity negatively affected the participants academic, mental and social wellbeing. Poor academic performance has been linked to food insecurity in children, adolescents and college students [9]. A recent study reported that the risk of anxiety and depression of food insecure freshmen is 3 times higher than their peers [13]. Similarly, another study found that poor nutrition is the second leading cause of mental health concerns among college students [31]. Although the participants talked about avoiding hanging out with friends during meal times because they did not have money to spend, it can be implied that the stigma associated with being food insecure played a role in their social isolation.

Majority of the participants in this study expressed reluctance in seeking or receiving food assistance from friends, parents, partners or food pantries. The major barrier noted by the researchers is the rationalization by the food insecure students that lacking adequate food was a normal experience and that they did not need or deserve help. Additionally, participants expressed their desire to be independent and feeling embarrassed about asking for help. Similar barriers have been reported among the general population and college students [32-34]. These barriers may contribute to low utilization of available resources among college students and this is supported by findings of a study that established that only 4% of students who are aware of the resources on campus actually utilized them [35]. There is need for campuses to initiate conversations and create awareness on food insecurity with the aim of destigmatizing food insecurity.

University administrators should consider strategies to assist affected students, for example, establish on campus community gardens and food pantries. The universities can also negotiate with the private companies running cafeterias on campus to offer subsidized nutritious meals and to establish food recovery programs with the aim of assisting needy students.

This exploratory study brings awareness to the lived experiences of food insecure college students and adds the voice of the food insecure college students to the growing knowledge on this issue. The findings of this study show that there are negative academic, health and nutrition related effects associated with food insecurity among college students. The findings of this study also show that food insecure students have added stress that affect their academic success, and that food insecure college students engage in dietary habits and sleep behaviors that might lead to eating and sleep disorders. There is need for multi-university ethnological and/or longitudinal studies to explore how food insecurity affects college students' academics, nutrition and health during undergraduate and graduate studies, and use the information to tailor make interventions targeting dietary/nutrition, sleep and stress management behaviors of college students. University academic counselors, nutrition and health practitioners can use this information to enhance their problem diagnosis to include screening for food insecurity to better serve the students. Universities can establish food pantries and/or provide subsidized meals for the students in need and can also engage in conversations with the aim of creating awareness and destigmatizing food insecurity and therefore providing support to students who would otherwise struggle in silence.

LIMITATIONS

One limitation of this study is that the participants were a mixture of, traditional and non-traditional students. There were two non-traditional students, one was married, and each had a

child. The effects of food insecurity among the non-traditional students may be different from those of the traditional students because their identity as college students may be affected by their other roles as parents and/or spouse and therefore the findings cannot be generalized to all college students. Future research should endeavor to recruit more non-traditional students and explore their experiences with food insecurity.

Another limitation of this study is that the interviewers were professionally trained student researchers, which may have made some participants uncomfortable and therefore affected their responses. It is possible that participants may have been biased by the interaction with students who doubled as researchers. During the interview and transcription process, the researchers noted long pauses and uncomfortable laughter which was interpreted as discomfort. There is stigma associated with food insecurity and it may have contributed to some participants feeling that their silent struggle is being exposed and they may have felt ashamed of disclosing some details of their experiences with food insecurity. In the current study, several measures were taken to attempt to reduce participants discomfort, but it is impossible to fully eliminate the effect of the student interviewer. Participants were reassured that the information they provide will be confidential and their identifies would be concealed. They were also told that they could withdraw from the study at any time during the interview.

CONCLUSIONS

This research has highlighted the fact that food insecurity is an issue among college students at a public southern university. The underlying cause of food insecurity among students is limited finances and it is worsened by the increasing cost of attending college. Food insecurity affects student's academics, mental, physical and social health. Future research should

investigate the longitudinal effects of food insecurity on academics, mental, physical and social health, from freshmen to senior year.

REFERENCES

1. Coleman-Jensen A, Gregory CA, Rabbit M, Singh A (2017, October) Definitions of Food Security. US Department of Agriculture Economic Research Service, Washington, DC.
2. Coleman-Jensen A, Rabbit MP, Gregory CA, Singh A (2017) Household Food Security in the United States in 2016. US Department of Agriculture Economic Research Service, Washington, DC.
3. Bruening M, Brennhofer S, van Woerden I, Todd M, Laska M (2016) Factors Related to the High Rates of Food Insecurity among Diverse, Urban College Freshmen. J Acad Nutr Diet. 116(9):1450-1457.
4. Chaparro MP, Zaghloul SS, Holck P (2009) Food insecurity prevalence among college students at the University of Hawai'i at Manoa. Public Health Nutr. 12(11):2097-2013.
5. Freudenberg N, Manzo L, Jones H, Kwan A, Tsui E, Gagnon M (2011) Food Insecurity at CUNY: Results from a Survey of CUNY Undergraduate Students A Report from: The Campaign for a Healthy CUNY.
6. Gaines A, Robb CA, Knol LL, Sickler S (2014) Examining the role of financial factors, resources and skills in predicting food security status among college students. Int J Consum Stud. 38(4):374-384.
7. Maroto ME, Snelling A, Linck H (2015) Food Insecurity Among Community College Students: Prevalence and Association with Grade Point Average. Community Coll J Res Pract. 39(6):515-526.
8. Morris LM, Smith S, Davis J, Null DB (2016) The Prevalence of Food Security and Insecurity Among Illinois University Students. J Nutr Educ Behav. 48(6):376-382.
9. Patton-López MM, López-Cevallos DF, Cancel-Tirado DI, Vazquez L 92014) Prevalence

and Correlates of Food Insecurity Among Students Attending a Midsize Rural University in Oregon. J Nutr Educ Behav. 46(3):209-214**.**

10. Weinfield NS, Mills et al (2014) Hunger in America 2014.
11. Goldrick-Rab S, Broton K, Eisenberg D (2015, December) Hungry to Learn: Addressing Food and Housing Insecurity Among the Undergraduates. Retrieved from http://wihopelab.com/publications/Wisconsin_hope_lab_hungry_to_learn.pdf.
12. National Center for Education Statistics (2017, May) The Condition of Education-Participation in Education, Undergraduate Enrollment.
13. Bruening M, Brennhofer S, van Woerden I, Todd M, et al. (2016) Factors related to the high rates of food insecurity among diverse, urban college freshmen. Journal of the Academy of Nutrition and Dietetics, 116(9), 1450-1457.
14. Patton-López MM, López-Cevallos DF, Cancel-Tirado DI, Vazquez L (2014). Prevalence and Correlates of Food Insecurity Among Students Attending a Midsize Rural University in Oregon. J Nutr Educ Behav. 46(3):209-214.
15. Alaimo K (2005) Food Insecurity in the United States: An Overview. Top Clin Nutr. 20(4):281-298.
16. Worthy SL, Jonkman J, Blinn-Pike L (2010) Sensation-Seeking, Risk-Taking, and Problematic Financial Behaviors of College Students. J Fam Econ Issues. 31(2):161-170.
17. Becker CB, Middlemass K, Taylor B, Johnson C, Gomez F (2017) Food insecurity and eating disorder pathology. Int J Eat Disord. 50(9):1031-1040.
18. Seligman HK, Laraia BA, Kushel MB (2010) Food insecurity is associated with chronic disease among low-income NHANES participants. J Nutr. 140(2):304-310.
19. Mirabitur E, Peterson KE, Rathz C, Matlen S, Kasper N (2016) Predictors of college-

student food security and fruit and vegetable intake differ by housing type. J Am Coll Heal. 64(7):555-564.

20. Winkleby MA, Cubbin C (2004) Changing patterns in health behaviors and risk factors related to chronic diseases, 1990-2000. Am J Health Promot. 19(1):19-27.
21. Strauss AL, Corbin JM (1998) Basics of Qualitative Research : Techniques and Procedures for Developing Grounded Theory. Sage Publications.
22. Glaser BG, Strauss AL (1967) The Discovery of Grounded Theory: Strategies for Qualitative Research. Aldine Publishing, Chicago, IL.
23. Gall J, Gall M, Borg W (1999) Applying educational research: A practical guide. Longman Publishing Group.
24. Larson NI, Perry CL, Story M, Neumark-Sztainer D (2006) Food Preparation by Young Adults Is Associated with Better Diet Quality. J Am Diet Assoc. 106(12):2001-2007.
25. Coleman-Jensen, AJ (2011) Working for Peanuts: Nonstandard Work and Food Insecurity Across Household Structure. J Fam Econ Issues.32(1):84–97.
26. Berkowitz SA, Seligman HK, Choudhry NK (2014) Treat or Eat: Food Insecurity, Cost-related Medication Underuse, and Unmet Needs. Am J Med. 27(4):303-310.e3.
27. Nielsen RB, Garasky S, Chatterjee S (2010) Food Insecurity and Out-of-Pocket Medical Expenditures: Competing Basic Needs. Fam Consum Sci Res J. 39(2):137-151.
28. Ma J, Baum S, Pender M, Bell DW (2015) Trends in College Pricing, 2015. Trends in Higher Education Series. College Board.
29. Bruening M, MacLehose R, Loth K, Story M, Neumark-Sztainer D (2012) Feeding a family in a recession: food insecurity among Minnesota parents. Am J Public Health. 102(3):520-526.

30. Dinour LM, Bergen D, Yeh M-C (2007) The Food Insecurity–Obesity Paradox: A Review of the Literature and the Role Food Stamps May Play. J Am Diet Assoc. 107(11):1952-1961.
31. Mi-Ting K, Peters Jr RJ, Ford K, Meshack A, Hill M (2013) The Relationship Between Perceived Psychological Distress, Behavioral Indicators and African American Female College Students Food Insecurity. Am J Health Stud. 28(3):127-133.
32. Fong K, Wright RA, Wimer C (2016) The cost of free assistance: Why low-income individuals do not access food pantries. J Sociol Soc Welf. 43, 71.
33. Tsang S, Holt AM, Azevedo E (2011) An assessment of the barriers to accessing food among food-insecure people in Cobourg, Ontario. Chronic Dis Inj. 31(3):121-128.
34. King J. (2017) Food Insecurity Among College Students-Exploring the Predictors of Food Assistance Resource Use.
35. Hughes R, Serebryanikova I, Donaldson K, Leveritt M (2011) Student food insecurity: The skeleton in the university closet. Nutr Diet. 68(1):27-32.

VI. MANUSCRIPT 4

A TEXT DELIVERED INTERVENTION TO IMPROVE DIETARY HABITS, STRESS MANAGEMENT BEHAVIORS AND CREATE AWARENESS OF FOOD ASSISTANCE RESOURCES AMONG COLLEGE STUDENTS

A Paper Submitted to the Journal of American College Health

ABSTRACT

Objective: To evaluate acceptance and effectiveness of health-related text messages on college students' dietary habits, stress management behaviors and awareness of food assistance resources.

Methods: Stratified random sampling was used to assign participants into either control or intervention group. The intervention group received 3 messages per week for 7 weeks and the control group received the same information in an email attachment at post-intervention. A pre and post online survey assessed the students' fruit and vegetable intake, perceived stress, hours of sleep and awareness of food assistance resources.

Results: The intervention group significantly ($P < 0.05$) reduced perceived stress from baseline 27.71 ± 5.18 to 17.33 ± 5.20 and increased intake of fruit and vegetable by 0.5 cup/day at post-intervention

Conclusion: Text delivered messages appear to be acceptable and have potential to promote positive dietary habits, stress management behaviors and create awareness of food assistance resources among college students.

Key words: College students, text messages, stress, sleep, fruits and vegetables, sugar sweetened beverages, food assistance resources.

INTRODUCTION

College students, often referred to as emerging adults, experience transitions in health-related behaviors as they adapt to life in college.[1] This transitional period is characterized by changes in dietary habits, stress and mealtime behaviors.[2–5] Additionally, emerging adults often lack resources and skills required for food preparation. These factors contribute to their increased risk for food insecurity.[6,7] Dietary habits that are consistent with the national dietary guidelines have been found to promote health, but college students do not meet these guidelines.[8–10] Studies have reported that college students have poor dietary habits and they do not meet their recommended daily intake of fruit and vegetable.[9,11,12] One study that examined the relationship between food insecurity and fruit and vegetable intake among college students found that food insecure students ate significantly lower daily servings of fruit and vegetable as compared to students with high food security controlling for confounding factors such as car access, race/ethnicity and gender.[13] Additionally, research indicate that college students skip meals, consume high amounts of snacks and high calorie food items such as sugar sweetened beverages (SSB).[14,15,16]

College students are prone to stress due to the transitional nature of college life.[17] According to the American College Health Association (ACHA) national survey, 57% of college students report elevated levels of stress.[18] Stress among college students is caused by numerous factors including adjusting to life away from family, developing relationships, need to maintain high level of academic achievement, juggling time demands from school and work, and increased responsibilities.[19] These stressors bring about change in sleeping patterns and may influence sleep quality and quantity.[4,17] Studies have shown that a majority of college students do not meet the recommended 9 hours of sleep per night.[4,17] Sufficient sleep quality and quantity are

critical determinants of health, and recently the US government added sleep as an objective in Healthy People 2020.[4,17,20] There is need for campus administrators and researchers to come up with interventions and avail information on stress management to help students cope better with stress.

Mobile phones have been used to provide widely accepted and inexpensive medium in which health related information can be communicated to the targeted populations.[21,22] In a study conducted by Pew Research Center, 94 % (n=273, aged 18-26 years) of college aged students reported having mobile phones and 89% reported having their phones in near proximity all the time, including bedtime.[23] College students with mobile phones reported receiving and sending a mean of 119 text messages a day.[24] With the incorporation of text messaging in the day-to-day lives of college students, it provides opportunities in which behavior change interventions can be delivered in a platform that is popular and easily accessed by the target population.[23–25]

The time that students spend in college is critical for the development of lifelong habits. Therefore, researchers should be deliberate in evaluating health behaviors in this age group and in providing appropriate and directed health education and information to improve health behaviors for optimum health outcomes. The purpose of this study was to evaluate the effectiveness of using text delivered messages to improve college students' dietary habits, stress management behaviors and create awareness of food assistance resources.

METHODS

This study was approved by the University's Institutional Review Board (IRB). An email was sent to conveniently selected professors in the college of human sciences requesting them to send a recruitment email with a link to the 6 item United States Department of Agriculture (USDA) food security survey to their classes. The same recruitment email was sent to on-campus food pantry and Campus Kitchen mailing list. The Campus Kitchen is a student led program that

fights hunger on campus and in the community by collecting unserved food from dining halls and redistributing it to those in need. To protect the identity of those who receive assistance from the food pantry and Campus Kitchens, the recruitment email was sent by the relevant staff and faculty. Inclusion criteria were: age ≥ 18 years and regular access to a mobile phone with a texting plan. When 50% of the target population (N) of either food secure or insecure was achieved, participation was closed for that category. The participants were randomly assigned to the control or intervention group based on their food security status in the order that they completed the online survey. The participants completed an online survey (Appendix C) powered by Qualtrics survey Software (version 2018; Qualtrics Provo, Utah) at baseline and after 7 weeks of text delivered intervention. The survey included a consent letter, demographic data form, food assistance resources awareness and utilization data collection tool,[26] National Cancer Institute fruits and vegetables screener,[27] sugar sweetened beverage screener,[15] Cohen's Perceived Stress screener,[28] hours of sleep,[29] and meal behavior data collection tool.[5] At post-intervention, the intervention group were asked to state the number of text messages they read during the intervention, what they liked most about the messages and to suggest their preferred medium for receiving health information.

The intervention messages were developed from formative interview data, tested using cognitive interviews,[30] and organized in 3 major themes: eating habits, stress management and food assistance resources awareness. The intervention group received 3 text messages per week for 7 consecutive weeks that contained information to encourage healthy dietary habits, stress management strategies and food assistance resources. The intervention participants were instructed during the consent process to text "STOP" if they no longer wished to receive text messages at any point in the study. The control group received an email attachment containing

all the messages at the end of the study. The participants were compensated for completing surveys ($5 at baseline and $10 at post-intervention).

Measures

Demographics. Demographic information including age, school classification status, gender and race/ethnicity were assessed at baseline.

Anthropometrics. Participants reported their weight (pounds) and height (feet and inches) respectively. These measurements were then transformed to kilograms (kg) and meters (m) to calculate body mass index (BMI) by: (BMI= weight (kg)/[height (m)]^2. BMI of each participant was classified as either underweight (<18.5), normal (18.5-24.9), overweight (25.0-29.9) and obese ($\geq$ 30).[31] Weight was a secondary study outcome.

Food assistance resource awareness. Questions to assess awareness and utilization of food assistance resources were adapted from a similar study.[26] Participants were asked, “Are you aware of places on campus where you can receive supplemental food if needed?”, and “Is there a food pantry on campus?” Those who answered “yes” were asked, “Have you ever used the on-campus food pantry or received free meals offered by the Campus Kitchens?”, if they answered “yes”, they were asked, “How times a semester do you get food from campus food pantry or Campus Kitchens?” Feelings towards utilizing the food pantry were also measured by asking the following question, “Please tell us how you may feel should you ever need to receive food from the food pantry or Campus Kitchens”. The participants were asked to rate each of the following feelings: encouraged, supported, satisfied, ashamed, embarrassed or loss of self-respect on a scale from 1 to 5; 1=strongly disagree, 2 = agree, 3= neither agree or disagree, 4 = disagree and 5 = strongly disagree. Participants likelihood to use food assistance resources were evaluated by asking the participants the following questions, “Please tell us how likely you are to use the

following resources: i) ask parents, friends, relatives, or partner to send money, ii) ask parents, friends, relatives, or partner to send/purchase food, iii) attend events offering free food, iv) borrow money or v) dumpster dive to receive food assistance? Responses were; i) extremely likely, ii) moderately likely, iii) neither likely or unlikely, iv) moderately unlikely and v) extremely unlikely.

Fruits and vegetables intake. The short form National Cancer Institute fruits and vegetables screener[27] was used to assess intake of fruit and vegetable as cups per day. This screener measures the frequency and average consumption of fruits and vegetables over the last one month. The variables data were transformed to cups per day before analysis.

Sugar sweetened beverage (SSB) intake. An adapted 8 question instrument[15] was used to assess the frequency and quantity intake of SSB in the previous month. The SSB queried included non-diet soda, fruit drinks, non-diet energy drinks and sweetened tea. The responses for frequency were never or less than 1 per month, 1-4 per month or 2-6 per week and the responses for quantity included none (all SSB), 12 oz can, restaurant glass/cup, 20 oz bottle (soda and fruit drinks), or 2 liter (soda) or 64 oz bottle (fruit drinks), 2 to16 oz energy drinks, and ≤ 12 oz, or ≥ 12 oz sweetened tea. The average number of kilocalories per day from SSB consumption were computed by converting amounts and frequency into ounces per day and multiplying by respective kilocalories per ounce.

Mealtime behavior. An adapted instrument[32] for measuring healthful meal time behavior was used to assess meal time planned self-regulation and self-instruction. For self-regulation, the participants were asked to specify how often in the last 3 months they had: “i) Purposely added vegetables to their meals and snacks; ii) planned quick, easy and healthy snacks; iii) “selected beverages with health in mind”; and iv) been flexible and sensible in food choices”. To assess

self-instruction for healthful mealtime behavior, participants were asked how often in the past 3 months they had: " i) Told myself to allow room for an occasional treat or dessert for just plain enjoyment; ii) told myself fruits and vegetables should be included in every meal; iii) reminded myself to eat in moderation; iv) reminded myself that healthy meals do not require a lot of work; v) reminded myself that planning quick and simple meals is important; and vi) reminded myself to think about my beverage choices". The responses were on a 5-point Likert scale: 1 = never, 2 = sometimes, 3 = regularly, 4 = often and 5 = always. Higher scores indicate healthful meal time behaviors.

Perceived Stress. Cohen's Perceived Stress Scale (10-item)[28] was used to measure participants perceived stress. This scale appraises the degree to which individuals find situations in their lives as stressful. The scale asked how overloaded, unpredictable and uncontrollable the participants found their lives in the last one month. The responses were on a 5-point Likert scale with 0 = never, 1 = almost never, 2 = sometimes, 3 = fairly often, and 4= very often. Questions 4,5, 7 and 8 were positively worded and therefore scores were reversed (0=4, 1=3, 2=2, 3=1 and 4=0). Higher scores indicate high perceived stress.

Hours of sleep. Participants were asked to report the average number of hours they sleep in a 24-hour period. This question is drawn from the Behavior Risk Factor Survey.[29]

Text message evaluation. During the study, the intervention group participants were asked to reply "yes" to text messages to indicate that they had received and read the intervention messages. Additionally, at post-intervention, intervention group participants were asked to report if they received and read the messages and indicate the number of messages they read. At post-intervention, the intervention participants were asked to suggest preferred medium (s) of message delivery and improvements for the intervention messages. The control participants were

asked to suggest their preferred method of health information communication at post-intervention.

Data Analysis

The data were analyzed using SPSS statistical software program (version 23; IBM SPSS, Armonk, New York). Descriptive statistics were used to analyze baseline demographic, food security status and anthropometric characteristics (BMI) and were expressed in frequencies and percentages. Chi square analysis were used to analyze differences in categorical data. One-way analyses of variance (ANOVA) was used to assess bivariate associations between food security status and fruit and vegetable intake, calories from sugar sweetened beverages, perceived stress scores, hours of sleep and weight of all participants at baseline. To determine differences between intervention and control group outcome variables, repeated measures ANOVA with fixed effects of time and group were performed. Significance was reported for time, group and group x time. Data from participants who did not complete post-intervention survey were excluded in the final analysis. P values ≤ 0.05 were considered as statistically significant.

RESULTS

Participants

Seventy-nine individuals started the screening survey, 76 completed the screener and 46 consented to participate in the study. Forty-four participants completed the post-intervention survey, of which 21 were intervention participants (96% retention). Majority of the participants in both groups were aged between 18-24 years (63%), were graduate students 46%, White (67%) and were categorized as “normal weight” (63%) based on BMI (Table 1).

Table 1. Characteristics of Study Participants at Baseline			
	Intervention (n=22)	**Control (n=24)**	**Total (n=46)**
Characteristic			
Demographics (%)			
Age			
18-24	12 (55)	17 (71)	29 (63)
≥ 25	10 (45)	7 (29)	17 (37)
Classification			
Sophomore	4 (18)	2 (8)	4 (13)
Junior	4 (18)	6 (25)	10 (22)
Senior	4 (18)	5 (21)	9 (20)
Graduate	10 (45)	11 (46)	21 (46)
Gender			
Male	4 (18)	5 (21)	9 (20)
Female	18 (82)	19 (79)	37 (80)
Race/Ethnicity			
African American	1 (5)	0 (0)	1 (2)
White	14 (64)	17 (71)	31 (67)
Hispanic or Latino	2 (9)	2 (8)	4 (9)
Asian	5 (23)	3 (13)	8 (17)
Multiracial	0 (0)	2 (8)	2 (4)
Food Security Status			
Food secure	10 (45)	10 (42)	20 (43)
Food insecure	12 (55)	14 (58)	26 (57)
Anthropometric measurements (%)			
Body Mass Index			
Underweight	1 (4)	0 (0)	1 (2)
Normal weight	14 (58)	15 (68)	29 (63)
Overweight and Obese	9 (36)	7 (32)	16 (35)

Eating Behavior

At post-intervention, although not statistically significant, the intervention participants increased their daily fruit and vegetable intake by half a cup whereas the control group intake remained essentially the same as measured by the National Cancer Institute fruits and vegetables.[27] The intervention and control group reduced the calories from the intake of SSB by 19 and 30 calories, respectively. Planned self-regulation and reported self-instruction scores for healthful mealtime behavior at baseline and post-intervention were approximately 3 on a scale of

1 to 5 for both groups, with higher score indicating greater intention for behavior change or current behavior (Table 2).

Hours of Sleep and Perceived Stress

At baseline, the food secure students had more hours of sleep than the food insecure students (7.90 ± 1.29 vs 6.68 ± 1.22, respectively; $P < 0.05$), Figure 1. There was significant group x time interaction for sleep; the intervention group reported a higher number of sleep hours (7.40 ± 1.37) compared to the control group (6.61 ± 1.03) at post-intervention (Table 2). There was significant time interaction for perceived stress; the intervention and control groups significantly reduced perceived stress when within group baseline and post-intervention scores were compared; 27.71 ± 5.18 to 17.33 ± 5.20 and 29.61 ± 6.28 to 20.43 ± 5.69; $P < 0.05$), respectively (Table 2).

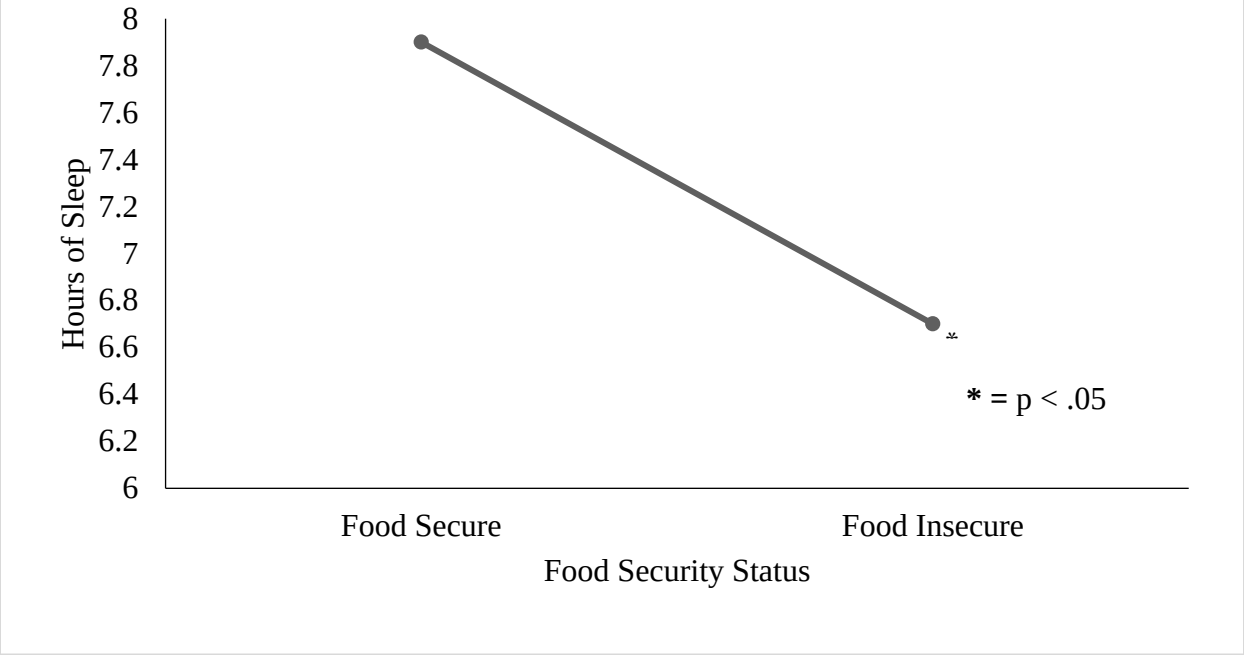

Figure 1. Baseline differences in hours of sleep by food security status

Table 2. Comparison of Intervention and Control Group Study Outcomes (Eating behavior, Perceived Stress, Sleep Hours, Mindful Eating and Weight) at Baseline and Post-intervention

				Significance[a]		
Characteristic		Baseline (Mean± SD)	Post-intervention (Mean± SD)	Time[b]	Group	Group X Time
Eating behavior						
Fruits and vegetables intake, cup/d	Intervention	2.94 ± 0.79	3.41 ± 0.92	0.174	0.439	0.345
	Control	2.89 ± 1.73	2.98 ± 1.15			
Sugar sweetened beverages, kcal/day	Intervention	80.81 ± 134.7	62.31 ± 126.94	0.469	0.703	0.864
	Control	102.70 ± 248.39	72.81 ± 166.41			
Mealtime behavior						
Planned self-regulation for healthful mealtime behavior	Intervention	3.29 ± 0.73	3.30 ± 0.79	0.514	0.551	0.600
	Control	3.35 ± 0.73	3.49 ± 0.95			
Reported self-instruction for healthful mealtime behavior	Intervention	3.38 ± 0.99	3.37 ± 0.90	0.970	0.286	0.898
	Control	3.12 ± 0.722	3.14 ± 0.84			
Sleep, hours/d	Intervention	7.00 ± 1.41	7.10 ± 1.41	0.104	0.885	0.037*
	Control	7.40 ± 1.37	6.61 ± 1.03			
Perceived stress	Intervention	27.71 ± 5.18	17.33 ± 5.20	0.000*	0.068	0.567
	Control	29.61 ± 6.28	20.43 ± 5.69			
**Weight	Intervention	63.20 ± 11.04	63.93 ± 11.46	0.716	0.424	0.565
	Control	63.88 ± 20.83	67.98 ± 16.46			

[a] Significance was set at $P \leq 0.05$ and was determined using repeated measures ANOVA with fixed effects of time and group using SPSS statistical software. [b] Pre and post comparison. * Significant difference. **Secondary study outcome.

Weight

For the secondary outcome of weight, there were no statistically significant differences when baseline and post-intervention measurements were compared for both groups (Table 2). However, food insecure students weighed significantly more than the food secure students at baseline and post-intervention (60.93 ± 14.76 vs 69.94 ± 12.86, respectively; $P < 0.05$), Figure 2.

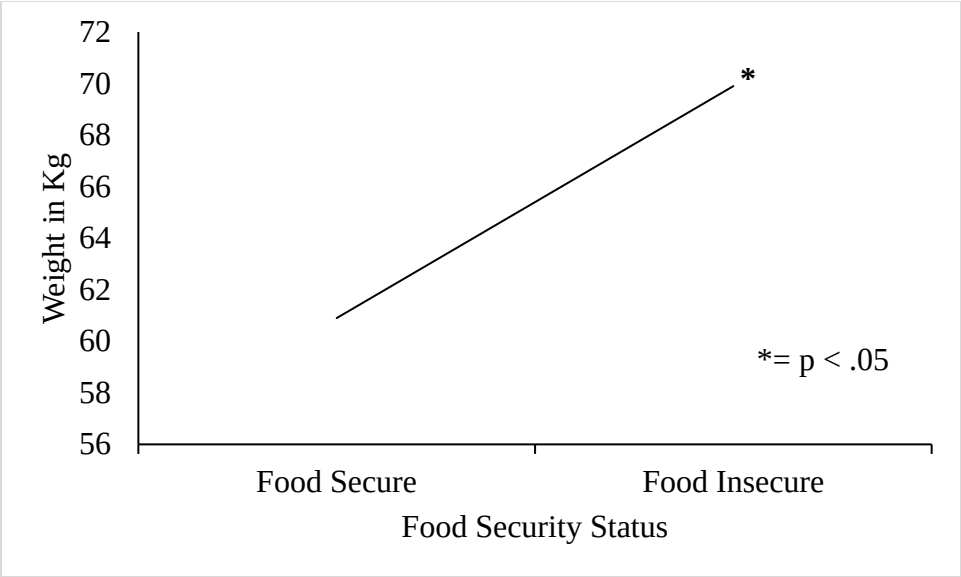

Figure 2. Post-intervention differences in weight by food security status

Food Assistance Resource Awareness and Utilization

At baseline, 39% of the all participants agreed that using the food pantry to get food assistance would make them feel encouraged, supported and satisfied (Figure 3). Also, the food insecure participants reported that they utilized the food pantry at least 4 times per semester. There was significant increase in the percentage of intervention participants who knew places on campus that provide supplemental food assistance and where the food pantry is located on campus (Table 3).

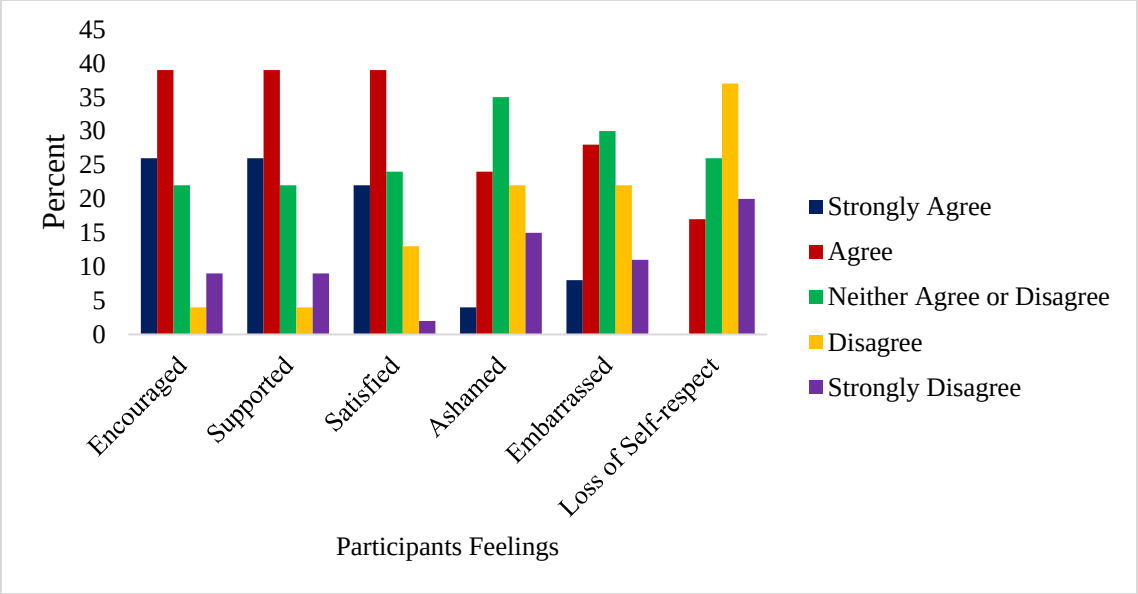

Figure 3. Study Participants Feelings About Utilizing the Food Pantry at Baseline (n=46).

Table 3. Comparison of Intervention and Control Study Participants Food Assistance Resource Awareness at Baseline and Post-intervention

		Baseline	Post-intervention	Change
		(%)	(%)	(%)
Are you aware of places on campus that provide supplemental food?	Intervention	77	100	23*
	Control	83	97	14
Is there a food pantry on campus?	Intervention	68	100	32*
	Control	83	91	8

Note. Results are presented based on percent affirmative answers given by participants. Chi square analysis were used to analyze the responses.
*Significant difference in the change in food assistance resources awareness between control and intervention group, $p < 0.05$.

Text Message Evaluation

One hundred percent of the intervention participants reported that they received and read the messages and there was 100% retention of participants. Fifty-seven percent of the intervention participants read 15-21 intervention text messages. A majority of the control (70%) and 38% of intervention participants reported that email is their most preferred method to receive health information. Some of the suggestions for improvements include: “start an Instagram page

to post healthy (food) pictures and ideas", "make messages participant specific" and "reduce the length of some of the messages." Two participants felt that the messages were "great".

DISCUSSION

College students often have unhealthy dietary habits that include low intake of fruits and vegetables,[3] and increased intake of fast foods and SSB.[14,15] Due to busy schedules and increased responsibility, college students have increased levels of stress and inadequate sleep.[18,33] Additionally, studies have shown that college students have increased risk of food insecurity due to increasing cost of attending college, developing food and financial management skills and limited income.[7,34] For these reasons, we assessed the effects of a 7-week text delivered intervention on eating habits (intake of fruit and vegetable, sugar sweetened beverages and meal time behavior), perceived stress, and awareness of food assistance resources in a random sample of college students in a public university in southeast United States.

Fruits and Vegetables Intake

As expected, at baseline, the intake of fruit and vegetable for both the intervention and control groups were consistent with that of other US college students and did not meet the recommended 5 or more daily servings of fruits and vegetables.[35,36] Although not statistically significant, the intervention group participants reported an increase in the intake of fruit and vegetable at post-intervention, whereas the control participants maintained their intake. Other studies reported similar outcomes in that there were small increases in fruit and vegetable intake at post-intervention.[37–39] These trends point to the existence of barriers to college students' intake of fruit and vegetable that includes access, costs and time constraints.[13,40] College students report that lack of grocery stores and transportation to access off campus stores as major environmental barriers to consumption of fruit and vegetable.[40] Furthermore, college students often have busy

schedules and are on limited budgets and report not having time to purchase fruit and vegetable regularly and find their cost to be expensive, respectively.[13,40] Given the benefits of fruits and vegetables in health promotion, there should be continued interventions and campaigns to promote intake of fruit and vegetable intake among college students.

Sugar Sweetened Beverages

Although there wasn't a significant difference in the calories from SSB between and within the intervention and control groups at baseline and at post-intervention, all the participants in this study reported lower intakes of sugar sweetened beverages compared to other young adults (20-34 years) in the US.[41] Similar findings were reported in two studies that evaluated the effectiveness of web-based and multi-modal interventions to modify dietary habits of college students in that they found no significant reduction in energy intake from SSB.[2,37] Increased intake of sugar sweetened beverages is positively associated with increased body weight and risk of obesity across all groups.[42] In the current study, a majority of study participants had normal BMI at baseline and at post-intervention. This can conservatively indicate that their normal BMI is linked with their low intake of calories from SSB.

Mealtime Behavior

Although the intervention participants did not report significant changes in planned self-regulation and self-instruction for healthful mealtime behavior, their mealtime behavior scores at post-intervention were similar to those reported by other student samples.[2] Due to busy class schedules and assignments, college students often develop poor eating habits such as snacking on unhealthy food items and skipping meals.[3] Healthful mealtime behavior such as budgeting and shopping for food, planning regular meals and healthy snacks have been associated with healthy dietary habits and weight maintenance by college students.[43] Additionally, planning and tracking

snacks and meals have been associated with reduced intake of SSB and greater intakes of fruit and vegetable.[32] It is important that healthful mealtime knowledge and skills are imparted on students early in their Freshmen years and continued throughout their college years.

Perceived Stress and Sleep.

Increased levels of stress are positively associated with reduced hours of sleep.[4] In the current study, participants in the intervention and control group had less than the 9 recommended hours of sleep per day[32] and less than amounts (8.4 hours) reported in another study.[4] The intervention group participants maintained their hours of sleep while the control group significantly reduced their sleep time when baseline and post-intervention hours of sleep were compared. Perceived stress among the intervention group participants significantly reduced at post-intervention. These results indicate that the text delivered messages encouraging positive stress management behaviors and thus were successful in reducing the intervention participants perceived stress.

Our study found that food insecure students utilize the on-campus food pantry at least 4 times a semester, this is twice the amount reported in a study that investigated predictors of food assistance resource use.[26] A recent study found that 30.8% of food insecure students were not aware of the existence of a food pantry on their campus.[26] Additionally, researchers reported that although 6.6% of food insecure students were aware of food assistance resources, only 2.3% utilized them.[34] As an increasing number of universities establish food pantries,[44] it is important to make students aware of the existence of such resources and to initiate conversations with students in order to identify barriers and facilitators of resource use.

Promising outcomes were observed in our study that used text delivered messages among college students. The100% retention of the intervention participants may be attributed to the fact

that text messaging is widely accepted and fully integrated into the lives of college students, and that text messages are not invasive. Also, the majority (57%) of the intervention participants reported reading 15-21 intervention messages. At the end of the study, one participant stated, "I thought they (messages) were great" this indicates acceptability of receiving health related information via text in this population. This study supports other evidence of acceptability of text-message based health information intervention.[38]

LIMITATIONS

This study had a few limitations, all measures were self-reported and therefore the responses were dependent on the participants' honesty and memory in answering the study questions. The sample was small, and the participants were not balanced in the student's gender and race/ethnicity. There was overrepresentation of White female students. Future studies should consider using multiple recruitment approaches to attract a more balanced group of participants that include more males and African American students . The intervention focused on three broad topics and this may explain the modest results in this study. We recommend that future researchers collect 24-hour diet recall data and examine the diet quality of food secure and food insecure college students. Lastly, since there was no long-term follow-up for this study, there is no way of measuring if the observed behavior changes had long lasting effects or if they occurred during the intervention period only. Future research should be longitudinal in nature to examine the long-term effect of text delivered messages on dietary habits, perceived stress and awareness of food assistance resources among college students.

CONCLUSIONS

The current study proved that text delivered messages were effective in reducing perceived stress scores, reducing calories from SSB, increasing the intake of fruit and vegetable, and

increasing awareness of food assistance resources among college students. Based on these changes, retention and positive evaluation comments made by study participants, text delivered messages were acceptable and effective for this audience. We recommend that future studies use repetitive text messages that include visual aids, as well as have long-term follow-ups to determine long-term behavior change. We also recommend that future studies evaluate diet quality of study participants using 24-hour dietary recall.

REFERENCES

1. Worthy SL, Jonkman J, Blinn-Pike L. Sensation-Seeking, Risk-Taking, and Problematic Financial Behaviors of College Students. *J Fam Econ Issues*. 2010;31(2):161-170.
2. Kattelmann KK, Bredbenner CB, White AA, et al. The effects of Young Adults Eating and Active for Health (YEAH): a theory-based Web-delivered intervention. *J Nutr Educ Behav*. 2014;46(6):S27-41. doi:10.1016/j.jneb.2014.08.007
3. Brunt A, Rhee Y, Zhong L. Differences in Dietary Patterns Among College Students According to Body Mass Index. *J Am Coll Heal*. 2008;56(6):629-634.
4. Wallace DD, Boynton MH, Lytle LA. Multilevel analysis exploring the links between stress, depression, and sleep problems among two-year college students. *J Am Coll Heal*. 2017;65(3):187-196.
5. Strong K, Parks S, Anderson E, Winnet R, Davy B. Weight gain prevention: identifying theory-based targets for health behavior change in young adults. *J Am Diet Assoc*. 2008;108(10):1708-1715.
6. Larson NI, Perry CL, Story M, Neumark-Sztainer D. Food Preparation by Young Adults Is Associated with Better Diet Quality. *J Am Diet Assoc*. 2006;106(12):2001-2007.
7. Gaines A, Robb CA, Knol LL, Sickler S. Examining the role of financial factors, resources and skills in predicting food security status among college students. *Int J Consum Stud*. 2014;38(4):374-384.
8. Papadaki A, Hondros G, Scott J, Kapsokefalou M. Eating habits of university students living at, or away from home in Greece. *Appetite*. 2007;49(1):169-176.
9. von Bothmer MIK, Fridlund B. Gender differences in health habits and in motivation for a

healthy lifestyle among Swedish university students. *Nurs Heal Sci*. 2005;7(2):107-118.

10. Davy S, Benes B, Driskell J. Sex differences in dieting trends, eating habits, and nutrition beliefs of a group of midwestern college students. *J Am Diet Assoc*. 2006;106(10):1673-1677.
11. Kelly N, Mazzeo S, Bean M. Systematic review of dietary interventions with college students: directions for future research and practice. *J Nutr Educ Behav*. 2013;45(4):304-313.
12. Dehdari T, Kharghani Moghadam M, Mansouri T, Saki A. Survey of daily fruit consumption status among girl students who are living in dormitories and its predictors based on the theory of planned behavior constructs. *Razi J Med Sci*. 2013;20(106):10-19.
13. Mirabitur E, Peterson KE, Rathz C, Matlen S, Kasper N. Predictors of college-student food security and fruit and vegetable intake differ by housing type. *J Am Coll Heal*. 2016;64(7):555-564.
14. Larson NI, Neumark-Sztainer DR, Story MT, Wall MM, Harnack LJ, Eisenberg ME. Fast Food Intake: Longitudinal Trends during the Transition to Young Adulthood and Correlates of Intake. *J Adolesc Heal*. 2008;43(1):79-86. doi:12.005
15. Smith West D, Bursac Z, Quimby D, et al. Self-Reported Sugar-Sweetened Beverage Intake among College Students*. *Obesity*. 2006;14(10):1825-1831.
16. Rosinger A, Herrick K, Gahche J, Park S. Sugar-sweetened Beverage Consumption Among U.S. Adults, 2011-2014. *NCHS Data Brief*. 2017;(270):1-8. http://www.ncbi.nlm.nih.gov/pubmed/28135185.
17. Lund H, Reider B, Whiting A, Prichard J. Sleep patterns and predictors of disturbed sleep in a large population of college students. *J Adolesc Heal*. 2010;46(2):124-132.

18. Fall 2017 Reference Group Executive Summary. http://www.acha-ncha.org/docs/NCHA-II_FALL_2017_REFERENCE_GROUP_EXECUTIVE_SUMMARY.pdf. Accessed April 23, 2018.

19. Clark CM, Nguyen DT, Barbosa-Leiker C. Student Perceptions of Stress, Coping, Relationships, and Academic Civility. *Nurse Educ*. 2014;39(4):170-174.

20. Department of Health and Human Services. Healthy People 2020. https://www.healthypeople.gov/. Accessed February 6, 2018.

21. Fjeldsoe BS, Marshall AL, Miller YD. Behavior Change Interventions Delivered by Mobile Telephone Short-Message Service. *Am J Prev Med*. 2009;36(2):165-173.

22. Cole-Lewis, Kershaw T. Text messaging as a tool for behavior change in disease prevention and management. *Epidemiol Rev*. 2010;32(1):56-69.

23. Lenhart, Amanda|Purcell, Kristen|Smith, Aaron|Zickuhr K. Social Media & Mobile Internet Use among Teens and Young Adults. Millennials. *Pew Internet Am Life Proj*. 2010.

24. Napolitano MA, Hayes S, Bennett GG, Ives AK, Foster GD. Using facebook and text messaging to deliver a weight loss program to college students. *Obesity*. 2013;21(1):25-31.

25. Aleman AMM, Wartman LK. Online Social Networking on Campus: Understanding What Matters in Student Culture (Review). *Rev High Educ*. 2009;33(2):301-303. doi:10.1353/rhe.0.0135

26. King J. Food Insecurity Among College Students-Exploring the Predictors of Food Assistance Resource Use. 2017. http://rave.ohiolink.edu/etdc/view?acc_num=kent1492466215893925. Accessed January

25, 2018.

27. Thompson F, Midthune D, Subar A, … LK-P health, 2004 undefined. Performance of a short tool to assess dietary intakes of fruits and vegetables, percentage energy from fat and fibre. *Public Health Nutr*. 2004;7(8):1097-1106.

28. Mikolajczyk RT, El Ansari W, Maxwell AE. Food consumption frequency and perceived stress and depressive symptoms among students in three European countries. *Nutr J*. 2009;8(1):31. doi:10.1186/1475-2891-8-31

29. CDC - BRFSS - Questionnaires. https://www.cdc.gov/brfss/questionnaires/index.htm. Accessed April 16, 2018.

30. Knafl K, Deatrick J, Gallo A, et al. The analysis and interpretation of cognitive interviews for instrument development. *Res Nurs Health*. 2007;30(2):224-234.

31. Body Mass Index (BMI) | Healthy Weight | CDC. https://www.cdc.gov/healthyweight/assessing/bmi/index.html. Accessed April 16, 2018.

32. Strong K, Parks S, Anderson E. Weight gain prevention: identifying theory-based targets for health behavior change in young adults. *J Am Diet Assoc*. 2008;108(10):1708-1715.

33. Lund H, Reider B. Sleep patterns and predictors of disturbed sleep in a large population of college students. *J Adolesc Heal*. 2010;46(2):124-132.

34. Hughes R, Serebryanikova I, Donaldson K, Leveritt M. Student food insecurity: The skeleton in the university closet. *Nutr Diet*. 2011;68(1):27-32.

35. Kang J, Ciecierski C, Malin E, et al. A latent class analysis of cancer risk behaviors among US college students. *Prev Med (Baltim)*. 2014;64:121-125.

36. *Spring 2016 Reference Group Executive Summary*. http://www.acha-ncha.org/docs/ncha-ii spring 2016 us reference group executive summary.pdf. Accessed April 18, 2018.

37. Shahril MR, Elena WP, Dali W, Lua PL. A 10-week multimodal nutrition education intervention improves dietary intake among university students: cluster randomised controlled trial. *J Nutr Metab*. 2013;2013.

38. Brown ON, O'Connor LE, Savaiano D. Mobile MyPlate: A Pilot Study Using Text Messaging to Provide Nutrition Education and Promote Better Dietary Choices in College Students. *J Am Coll Heal*. 2014;62(5):320-327.

39. Richards A, Kattelmann K, Dietetic CR-J of the A, 2006 undefined. Motivating 18-to 24-year-olds to increase their fruit and vegetable consumption. *J Am Diet Assoc*. 2006;106(9):1005-1411.

40. Walker B, Wolf M, Schroeter C. An Examination of College Students' Produce Consumption and Purchasing Behavior: A Case Study in California. *J Food Distrib Res*. 2009;40(1).

41. Han E, Powell LM. Consumption Patterns of Sugar-Sweetened Beverages in the United States. *J Acad Nutr Diet*. 2013;113(1):43-53. doi:10.1016/J.JAND.2012.09.016

42. Luger M, Lafontan M, Bes-Rastrollo M, Winzer E, Yumuk V, Farpour-Lambert N. Sugar-Sweetened Beverages and Weight Gain in Children and Adults: A Systematic Review from 2013 to 2015 and a Comparison with Previous Studies. *Obes Facts*. 2017;10(6):674-693.

43. Quick V, Wall M, Larson N, Haines J, Neumark-Sztainer D. Personal, behavioral and socio-environmental predictors of overweight incidence in young adults: 10-yr longitudinal findings. *Int J Behav Nutr Phys Act*. 2013;10(1):37.

44. Members – College and University Food Bank Alliance. https://sites.temple.edu/cufba/members/. Accessed March 5, 2018.

VII. GENERAL CONCLUSIONS

Food insecurity is an important public health issue that affects college students and has the potential to negatively affect their academic success and health. Although there is currently no national data on the rate of food insecurity among US college students, research into this issue has grown in the recent past and it is estimated that the prevalence of food insecurity among college students is 42%.[79] Our findings indicate that 31% of sampled students in a public university in southeast United States were food insecure. Other similar studies conducted in different campus settings in the US found that the prevalence of food insecurity range from 12 to 67%.[1–3,5,6,9,80–85] The current research and other past studies demonstrate that there is an "invisible" population of college students who struggle with food insecurity.

The risk factors significantly associated with food insecurity in our study include: smoking, living off-campus with relatives or parents and living on-campus alone. To the best of our knowledge, our study is the first to investigate the association of food insecurity and smoking status among college students and therefore comparison with other studies in a similar setting is difficult. Corresponding to our findings, studies have found that living alone (on or off campus) is associated with increased risk for food insecurity.[2,3,9] Past studies have demonstrated that living with parents or relatives is associated with decreased risk of food insecurity,[2,3,9] however, our results contrast with these findings. Therefore, there is need to investigate the role of parents and relatives in providing safety nets to food insecure college students.

This research explored the lived experiences of food insecure college students. Some food insecure students that we interviewed reported that they had experienced food insecurity in their childhood and before joining college. These finding are consistent with results from a recent study that found that childhood food insecurity was significantly linked to college students' food insecurity.[85] Our findings indicated that competing financial demands such as fixed bills and unexpected expenses reduce their food dollar and therefore contribute to food insecurity. To cope with food insecurity, students reported working odd jobs and taking extra shifts to raise money to buy food and for basic life necessities. Students also reported reducing the quality and quantity of food and skipping eating occurrences. Additionally, there were some food insecurity students who showed great skill in budgeting and shopping for food while others lacked skills and they reported that they start planning and budgeting for their meals when they are almost running out of money. The association between food resource adequacy and financial management skills like budgeting and food security status is mixed, two past studies report that students who track their expenses are more likely to be food insecure,[1,16] whereas a study conducted among food insecurity adults indicated that the risk of food insecurity reduced among adults who budget.[86]

This study established that food insecurity affects students' academics and health. Food insecure students reported that they did not have enough energy to stay awake in class or complete assignments and consequently their grades were affected in the long run. Previous studies[2,3,6,9] similarly reported that food insecure students had lower GPA's as compared to food secure students. Also, this study established that food insecure students mental, physical and social health were affected. The affected students reported being moody, stressed, anxious, angry, tired, lethargic and not being able to socialize with other students. Poor health has

previously been reported to be related to food insecurity.[5] These findings demonstrate food insecurity is a barrier to student academic success and general wellbeing. In response to student food insecurity, a growing number of college campuses have established on-campus food pantries.[7] However, the efficacy of food pantries in decreasing food insecurity among college students has not been investigated.

Text messaging is fully integrated into the lives of college students and therefore provide a low-cost medium in which behavior change interventions can be implemented.[29,30,61,87] Our study demonstrated that text delivered messages can modify dietary habits such as reduce intake of calories from sugar sweetened beverages and increase fruit and vegetable intake, reduce perceived stress and increase awareness of food assistance resources. Similar results of change in dietary habits have been reported with other health and nutrition-related text message interventions. In a population of 18-24-year-old college students, nutrition text messages in addition to brochures and conventional lectures were delivered over a 10-week period. Results showed that compared to control group, intervention participants significantly reduced the intake of processed foods and increased the intake of fruits, 100% fruit juice, eggs and fish.[61] In a text-based intervention to promote sleep hygiene, the intervention participants received bi-weekly text messages for 6 weeks to aid them in improving sleep hygiene, quality and knowledge.[64] The intervention group participants reported good sleep quality at post-intervention.

Recommendations for Future Research

- More research is needed to determine the longitudinal impacts of food insecurity on academic and health among college students.
- Additional qualitative research is needed to explore the perceptions of food insecurity by college students and university administrators.

- Qualitative examination of the barriers of utilization of food assistance resources is recommended.
- Additional research using repetitive and interactive messaging to modify dietary habits, stress management behaviors and increase awareness of food assistance resources awareness is recommended.
- Future studies should investigate the efficacy of food pantries and other supplementary food assistance resources in decreasing food insecurity among college students

REFERENCES

1. Gaines A, Robb CA, Knol LL, Sickler S. Examining the role of financial factors, resources and skills in predicting food security status among college students. *Int J Consum Stud*. 2014;38(4):374-384.
2. Morris LM, Smith S, Davis J, Null DB. The Prevalence of Food Security and Insecurity Among Illinois University Students. *J Nutr Educ Behav*. 2016;48(6):376-382.e1. doi:10.1016/J.JNEB.2016.03.013
3. Pia Chaparro M, Zaghloul SS, Holck P, Dobbs J. Food insecurity prevalence among college students at the University of Hawai'i at Mānoa. *Public Health Nutr*. 2009;12(11):2097-2103.
4. Mirabitur E, Peterson KE, Rathz C, Matlen S, Kasper N. Predictors of college-student food security and fruit and vegetable intake differ by housing type. *J Am Coll Heal*. 2016;64(7):555-564.
5. Payne-Sturges DC, Tjaden A, Caldeira KM, Vincent KB, Arria AM. Student Hunger on Campus: Food Insecurity Among College Students and Implications for Academic Institutions. *Am J Heal Promot*. 2018;32(2):349-354.
6. Patton-López MM, López-Cevallos DF, Cancel-Tirado DI, Vazquez L. Prevalence and correlates of food insecurity among students attending a midsize rural university in Oregon. *J Nutr Educ Behav*. 2014;46(3):209-214.
7. Members – College and University Food Bank Alliance. https://sites.temple.edu/cufba/members/. Accessed March 5, 2018.

8. Weinfield NS, Mills WG, Institute U, et al. Hunger in America 2014 National Report Prepared for Feeding America. 2014. http://help.feedingamerica.org/HungerInAmerica/hunger-in-america-2014-full-report.pdf. Accessed January 25, 2018.
9. Maroto ME, Snelling A, Linck H. Food Insecurity Among Community College Students: Prevalence and Association With Grade Point Average. *Community Coll J Res Pract*. 2015;39(6):515-526.
10. Pine A, de Souza R. Including the Voices of Communities in Food Insecurity Research: An Empowerment-based Agenda for Food Scholarship. *J Agric Food Syst Community Dev*. 2013;3(4):1-9.
11. Alaimo K, Olson C, Pediatrics EF-, 2001 undefined. Food insufficiency and American school-aged children's cognitive, academic, and psychosocial development. *Pediatrics*. 2001;108(1):44-53.
12. Pan L, Sherry B, Njai R. Food insecurity is associated with obesity among US adults in 12 states. *J Acad Nutr Diet*. 2012;12(9):1403-1409.
13. Parker L. Food Insecurity and Obesity: A Dual Challenge for Low-Income Families. *Zero Three*. 2007;28(1):24-30.
14. Kirkpatrick S, nutrition VT. Food insecurity is associated with nutrient inadequacies among Canadian adults and adolescents. *J Nutr*. 2008;138(3):604-612.
15. Gowda C, Hadley C, Aiello AE. The Association Between Food Insecurity and Inflammation in the US Adult Population. *Am J Public Health*. 2012;102(8):1579-1586.
16. Hughes R, Serebryanikova I, Donaldson K, Leveritt M. Student food insecurity: The skeleton in the university closet. *Nutr Diet*. 2011;68(1):27-32.

17. Winicki J, policy KJ. Food insecurity and hunger in the kindergarten classroom: its effect on learning and growth. *Contemp Econ Policy*. 2003;21(2):145-157.

18. Murphy JM, Wehler CA, Pagano ME, Little M, Kleinman RE, Jellinek MS. Relationship between hunger and psychosocial functioning in low-income American children. *J Am Acad Child Adolesc Psychiatry*. 1998;37(2):163-170.

19. Mi-Ting K, Peters Jr RJ, Ford K, Meshack A, Hill M. The Relationship Between Perceived Psychological Distress, Behavioral Indicators and African American Female College Students Food Insecurity. *Am J Health Stud*. 2013;28(3):127-133.

20. Devlin M. Bridging socio-cultural incongruity: conceptualising the success of students from low socio-economic status backgrounds in Australian higher education. *Stud High Educ*. 2013;38(6):939-949.

21. Wladis C, Hachey AC, Conway KM. The Representation of Minority, Female, and Non-Traditional STEM Majors in the Online Environment at Community Colleges. *Community Coll Rev*. 2015;43(1):89-114.

22. Nelson B, Froehner M, Research BG-I for WP, 2013 undefined. *College Students with Children Are Common and Face Many Challenges in Completing Higher Education. Briefing Paper# C404.*; 2013.

23. Kahu ER, Stephens C, Leach L, Zepke N. The engagement of mature distance students. *High Educ Res Dev*. 2013;32(5):791-804.

24. Altbach PG, Reisberg L, Rumbley LE. *Trends in Global Higher Education: Tracking an Academic Revolution*. Paris, France; 2009. https://s3.amazonaws.com/academia.edu.documents/30910755/Altbach__Reisberg__Rumbley_Tracking_an_Academic_Revolution__UNESCO_2009.pdf?AWSAccessKeyId=AKI

AIWOWYYGZ2Y53UL3A&Expires=1520372577&Signature=%2FS84YH4kGlzGZqa1cJoOGjejGVA%3D&response-content-disposi. Accessed March 6, 2018.

25. Davis D, Davis D, Mackintosh B. Making a difference: Australian international education. 2011. https://scholar.google.com/scholar?hl=en&as_sdt=0%2C1&q=Davis%2C+D.%2C+Mackintosh%2C+B.+%282012%29.+Making+a+Difference%3A+Australian+International+Education.+Sydney%3A+New+South+Publishing.&btnG=. Accessed March 6, 2018.

26. Fredman P. *Universities as Role Models for Sustainable Development*.; 2012. www.gu.se/miljo. Accessed March 6, 2018.

27. Patrick K, Raab F, Adams MA, et al. A text message-based intervention for weight loss: randomized controlled trial. *J Med Internet Res*. 2009;11(1):e1.

28. Aleman AMM, Wartman LK. Online Social Networking on Campus: Understanding What Matters in Student Culture (Review). *Rev High Educ*. 2009;33(2):301-303. doi:10.1353/rhe.0.0135

29. Lenhart, Amanda|Purcell, Kristen|Smith, Aaron|Zickuhr K. Social Media & Mobile Internet Use among Teens and Young Adults. Millennials. *Pew Internet Am Life Proj*. 2010.

30. Napolitano MA, Hayes S, Bennett GG, Ives AK, Foster GD. Using facebook and text messaging to deliver a weight loss program to college students. *Obesity*. 2013;21(1):25-31.

31. Coleman-Jensen A, Rabbitt MP, Gregory CA, Singh A. Household Food Security in the United States in 2016. 2017. https://www.ers.usda.gov/webdocs/publications/84973/err-237.pdf?v=42979. Accessed March 2, 2018.

32. Coleman-Jensen A, Nord M, Andrews M, Carlson S. Household Food Security in the United States in 2011. 2012. https://www.ers.usda.gov/webdocs/publications/45020/30967_err141.pdf?v=41165. Accessed February 6, 2018.

33. Philips M. Cost of College on the Rise (Again) - Freakonomics. http://freakonomics.com/2011/10/27/cost-of-college-on-the-rise-again/. Published 2011. Accessed February 6, 2018.

34. Holben D. Position of the American Dietetic Association: Food Insecurity in the United States. *J Am Diet Assoc*. 2010;110(9). doi:10.1016/j.jada.2010.07.015

35. Alaimo K. Food Insecurity in the United States: An Overview : Topics in Clinical Nutrition. *Top Clin Nutr*. 2005;20(4):281-298.

36. Coleman-Jensen A, Gregory C, Singh A. *Household Food Security in the United States in 2013*.; 2014. https://www.ers.usda.gov/webdocs/publications/45265/48787_err173.pdf?v=42265. Accessed February 6, 2018.

37. Worthy SL, Jonkman J, Blinn-Pike L. Sensation-Seeking, Risk-Taking, and Problematic Financial Behaviors of College Students. *J Fam Econ Issues*. 2010;31(2):161-170.

38. How America Pays for College | Sallie Mae. https://www.salliemae.com/research/how-america-pays-for-college/. Published 2017. Accessed March 13, 2018.

39. Freudenberg N, Manzo L, Jones H, Kwan A, Tsui E, Gagnon M. Food Insecurity at CUNY: Results from a Survey of CUNY Undergraduate Students A Report from: The Campaign for a Healthy CUNY. 2011. https://www.gc.cuny.edu/CUNY_GC/media/CUNY-Graduate-Center/PDF/Centers/Center

for Human Environments/cunyfoodinsecurity.pdf. Accessed January 24, 2018.

40. Evans BA, Goldrick-Rab S, Broton KM. *Public Testimony on Hunger in Higher Education*.; 2015. www.wihopelab.com. Accessed March 13, 2018.

41. Anderson K, Swanson J. *Rural Families–Welfare Reform & Food Stamps. Policy Brief*. Ithaca, NY; 2002.

42. Larson NI, Perry CL, Story M, Neumark-Sztainer D. Food Preparation by Young Adults Is Associated with Better Diet Quality. *J Am Diet Assoc*. 2006;106(12):2001-2007.

43. Nord M, Coleman-Jensen A, Andrews M, Carlson S. Household Food Security in the United States, 2009. 2010. https://www.ers.usda.gov/webdocs/publications/44776/7024_err108_1_.pdf?v=41056. Accessed February 6, 2018.

44. Nutrition BL-A in, 2013 undefined. Food Insecurity and Chronic Disease–. *Adv Nutr*. 2013;4(2):203-212.

45. Hanson K, clinical LC. Food insecurity and dietary quality in US adults and children: a systematic review–. *Am J Clin Nutition* . 2014;100(2):648-692.

46. Seligman HK, Laraia BA, Kushel MB. Food insecurity is associated with chronic disease among low-income NHANES participants. *J Nutr*. 2010;140(2):304-310.

47. Nguyen BT, Shuval K, Bertmann F, Yaroch AL. The Supplemental Nutrition Assistance Program, Food Insecurity, Dietary Quality, and Obesity Among US Adults. *Am J Public Health*. 2015;105(7):1453-1459.

48. Ramsey R, Giskes K, Turrell G, nutrition DG-P health, 2012 undefined. Food insecurity among adults residing in disadvantaged urban areas: potential health and dietary consequences. *Public Health Nutr*. 2012;15(2):227-237.

49. Brown L, Dresen R, Eggett D. College students can benefit by participating in a prepaid meal plan. *J Am Diet Assoc*. 2005;105(3):445-448.

50. Winkleby MA, Cubbin C. Changing Patterns in Health Behaviors and Risk Factors Related to Chronic Diseases, 1990–2000. *Am J Heal Promot*. 2004;19(1):19-27.

51. Liu Y, Njai RS, Greenlund KJ, Chapman DP, Croft JB. Relationships Between Housing and Food Insecurity, Frequent Mental Distress, and Insufficient Sleep Among Adults in 12 US States, 2009. *Prev Chronic Dis*. 2014;11.

52. Thurber CA, Walton EA. Homesickness and Adjustment in University Students. *J Am Coll Heal*. 2012;60(5):415-419.

53. Beiter R, Nash R, Mccrady M, et al. The prevalence and correlates of depression, anxiety, and stress in a sample of college students. *J Affect Disord*. 2014;173:90-96.

54. Doom JR, Haeffel GJ. Teasing Apart the Effects of Cognition, Stress, and Depression on Health. *Am J Health Behav*. 2013;37(5):610-619.

55. Coleman-Jensen, Rabbitt MP, Gregory CA, Singh A. USDA ERS - Household Food Security in the United States in 2014. https://www.ers.usda.gov/publications/pub-details/?pubid=45428. Accessed February 6, 2018.

56. Zekeri AA. The adoption of electronic benefit transfer card for delivering food stamp benefits in Alabama: Perceptions of college students participating in the food stamp program. *Coll Stud J*. 2004;38(4):602-607. http://go.galegroup.com/ps/i.do?id=GALE%7CA126386900&sid=googleScholar&v=2.1&it=r&linkaccess=fulltext&issn=01463934&p=AONE&sw=w. Accessed March 30, 2018.

57. Fjeldsoe BS, Marshall AL, Miller YD. Behavior Change Interventions Delivered by

Mobile Telephone Short-Message Service. *Am J Prev Med*. 2009;36(2):165-173.

58. Donaldson EL, Fallows S, Morris M. A text message based weight management intervention for overweight adults. *J Hum Nutr Diet*. 2014;2:90-97.

59. Gerber BS, Stolley MR, Thompson AL, Sharp LK, Fitzgibbon ML. Mobile phone text messaging to promote healthy behaviors and weight loss maintenance: a feasibility study. *Health Informatics J*. 2009;15(1):17-25.

60. Kim H-S. A randomized controlled trial of a nurse short-message service by cellular phone for people with diabetes. *Int J Nurs Stud*. 2007;44(5):687-692.

61. Shahril MR, Elena WP, Dali W, Lua PL. A 10-week multimodal nutrition education intervention improves dietary intake among university students: cluster randomised controlled trial. *J Nutr Metab*. 2013;2013.

62. Brown ON, O'Connor LE, Savaiano D. Mobile MyPlate: A Pilot Study Using Text Messaging to Provide Nutrition Education and Promote Better Dietary Choices in College Students. *J Am Coll Heal*. 2014;62(5):320-327.

63. Prestwich A, Perugini M, Health RH-P and, 2009 undefined. Can the effects of implementation intentions on exercise be enhanced using text messages? *Psychol Heal*. 2009;24(6):677-687.

64. Gipson CS, Chilton JM, Dickerson SS, Alfred D, Haas BK. Effects of a sleep hygiene text message intervention on sleep in college students. *J Am Coll Heal*. 2018;00(00):00-00.

65. Carbone ET, Campbell MK, Honess-Morreale L. Use of cognitive interview techniques in the development of nutrition surveys and interactive nutrition messages for low-income populations. *J Am Diet Assoc*. 2002;102(5):690-696.

66. Willis GB (Gordon B. *Cognitive Interviewing : A Tool for Improving Questionnaire*

Design. Sage Publications; 2005.

67. Alaimo K, Olson CM, Frongillo EA. Importance of Cognitive Testing for Survey Items: An Example From Food Security Questionnaires. *J Nutr Educ*. 1999;31(5):269-275.
68. Greenwald AG. Cognitive learning, cognitive response to persuasion, and attitude change. *Psychol Found Attitudes*. 1968:147-170.
69. Kreuter M, Bull F, Clark E, Psychology DO-H, 1999 undefined. Understanding how people process health information: a comparison of tailored and nontailored weight-loss materials. *psycnet.apa.org*.
70. Cacioppo JT, Petty RE, Kao CF. The Efficient Assessment of Need for Cognition. *J Pers Assess*. 1984;48(3):306-307. doi:10.1207/s15327752jpa4803_13
71. Willis GB. Cognitive Interviewing A "How To" Guide Reducing Survey Error through Research on the Cognitive and Decision Processes in Surveys. In: *Reducing Survey Error through Research on the Cognitive and Decision Process in Surveys*. Reserach Triangle Institute; 1999. http://www.chime.ucla.edu/publications/docs/cognitive interviewing guide.pdf. Accessed May 10, 2018.
72. Patton MQ. *Qualitative Evaluation and Research Methods*. 2nd ed. Thousand Oaks, CA: Sage Publications; 1990.
73. Mukigi D, Thornton K, Binion A, et al. Food Insecurity among College Students: An Exploratory Study. *J Nutr Heal Sci J Nutr Heal Sci*. 2018;5(1).
74. Kattelmann KK, White AA, Greene GW, et al. Development of Young Adults Eating and Active for Health (YEAH) internet-based intervention via a community-based participatory research model. *J Nutr Educ Behav*. 2014;46(2):S10-25.
75. Dietary Guidelines | Choose MyPlate. https://www.choosemyplate.gov/dietary-guidelines.

Accessed May 31, 2018.

76. Kattelmann KK, Bredbenner CB, White AA, et al. The effects of Young Adults Eating and Active for Health (YEAH): a theory-based Web-delivered intervention. *J Nutr Educ Behav*. 2014;46(6):S27-41. doi:10.1016/j.jneb.2014.08.007

77. Miles M, Huberman A. *Qualitative Data Analysis: An Expanded Sourcebook*. 2nd ed. Thousand Oaks, CA: Sage; 1994.

78. Borg W. *Applying Educational Research: A Practical Guide*. 3rd ed. White Plains, NY: Longman Publishing Group; 1993.

79. Bruening M, Argo K, Payne-Sturges D, Laska MN. The Struggle Is Real: A Systematic Review of Food Insecurity on Postsecondary Education Campuses. *J Acad Nutr Diet*. 2017;117(11):1767-1791.

80. McArthur L, Ball L, Danek A, education DH-J of nutrition, 2017 undefined. A High Prevalence of Food Insecurity Among University Students in Appalachia Reflects a Need for Educational Interventions and Policy Advocacy. *J Nutr Educ Behav*. 2017.

81. Goldrick-Rab S, Richardson J, Hernandez A. *Hungry and Homeless in College:Results from a National Study of Basic Needs Insecurity in Higher Education*. Madison, WI; 2017. http://wihopelab.com/publications/hungry-and-homeless-in-college-report.pdf. Accessed April 30, 2018.

82. Bruening M, van Woerden I, Todd M, Laska MN. Hungry to learn: the prevalence and effects of food insecurity on health behaviors and outcomes over time among a diverse sample of university freshmen. *Int J Behav Nutr Phys Act*. 2018;15(1):9.

83. Tsui E, Freudenberg N, Manzo L, Jones H, Kwan A, Gagnon M. *Housing Instability at CUNY: Results from a Survey of CUNY Undergraduate Students A Report from: The*

Campaign for a Healthy CUNY.; 2011. https://www.gc.cuny.edu/CUNY_GC/media/CUNY-Graduate-Center/PDF/Centers/Center for Human Environments/cunyhousinginstability.pdf. Accessed March 13, 2018.

84. Luke Wood BJ, Harris Iii F, Delgado NR. *Struggling to Survive – Striving to Succeed: Food and Housing Insecurities in the Community College*.; 2017. https://www.luminafoundation.org/files/resources/food-and-housing-report.pdf. Accessed April 30, 2018.

85. Martinez SM, Webb K, Frongillo EA, Ritchie LD. Food insecurity in California's public university system: What are the risk factors? *J Hunger Environ Nutr*. 2018;13(1):1-18.

86. Gundersen CG, Garasky SB. Financial Management Skills Are Associated with Food Insecurity in a Sample of Households with Children in the United States. *J Nutr*. 2012;142(10):1865-1870. https://academic.oup.com/jn/article/142/10/1865/4630685.

87. Cole-Lewis H, Kershaw T. Text messaging as a tool for behavior change in disease prevention and management. *Epidemiol Rev*. 2010;32(1):56-69.

APPENDIX A

Consent Letters

AUBURN UNIVERSITY

COLLEGE OF HUMAN SCIENCES

Department of Nutrition, Dietetics, and Hospitality Management

(NOTE: DO NOT AGREE TO PARTICIPATE UNLESS AN IRB APPROVAL STAMP WITH CURRENT DATES HAS BEEN APPLIED TO THIS DOCUMENT.)

INFORMATION LETTER

For a Research Study entitled

"Food Security Status Among College Students Enrolled at Auburn University"

You are invited to participate in a research study to evaluate food security status among college students enrolled at Auburn University. The study is being conducted by Dorcas Mukigi, a graduate student from Department of Nutrition, Dietetics, and Hospitality Management, Auburn University. You are invited to participate because you are a student at Auburn University and are age 19 or older.

Your participation is completely voluntary. If you decide to participate in this research study, you will be asked to complete an electronic anonymous survey hosted at Qualtrics.com. Your total time commitment will be approximately 20 minutes.

There are minimal foreseeable risks in this study. Your participation will contribute in understanding of the food security status and correlates of food insecurity among college students.

If you change your mind about participating, you can withdraw at any time during the study by simply closing the browser. Your participation is completely voluntary. Your decision about whether or not to participate or to stop participating will not jeopardize your future relations with Auburn University, the Department of Department of Nutrition, Dietetics, and Hospitality Management.

The Auburn University
Institutional Review Board has
approved this Document for use
from
08/19/2016 to 08/18/2019
Protocol # 16-319 EX 1608

Any data obtained in connection with this study will remain anonymous. Information collected through your participation may be used to fulfill an educational requirement, published in a professional journal, and/or presented at a professional meeting.

If you have questions about this study, **please** contact Dr. Onikia Brown at onbrown@auburn.edu or (334) 844-3161.

If you have questions about your rights as a research participant, you may contact the Auburn University Office of Research Compliance or the Institutional Review Board by phone (334)-844-5966 or e-mail at IRBadmin@auburn.edu or IRBChair@auburn.edu.

HAVING READ THE INFORMATION PROVIDED, YOU MUST DECIDE IF YOU WANT TO PARTICIPATE IN THIS RESEARCH PROJECT. IF YOU DECIDE TO PARTICIPATE, THE DATA YOU PROVIDE WILL SERVE AS YOUR AGREEMENT TO DO SO. THIS LETTER IS YOURS TO KEEP.

Principal Investigator Date 8/23/2016

The Auburn University Institutional Review Board has approved this Document for use from 08/19/2016 to 08/18/2019 Protocol # 16-319 EX 1608

The Auburn University Institutional Review Board has approved this document for use from 08/19/2016 to 08/18/2019 Protocol # 16-319 EX 1608.

AUBURN UNIVERSITY

COLLEGE OF HUMAN SCIENCES

Department of Nutrition, Dietetics, and Hospitality Management

(NOTE: DO NOT AGREE TO PARTICIPATE UNLESS AN IRB APPROVAL STAMP WITH CURRENT DATES HAS BEEN APPLIED TO THIS DOCUMENT.)

INFORMED CONSENT

For a Research Study entitled
"Food Security Status Among College Students Enrolled at Auburn University"

You are invited to participate in a research study whose purpose is to determine the impact of experiences of hunger in college students at Auburn University. The study is being conducted by Dr. Brown and Dorcas Mukigi from the Department of Nutrition, Dietetics, and Hospitality Management, Auburn University. You are invited to participate because you are a student at Auburn University and are age 19 or older.

Your participation is completely voluntary. If you decide to participate in this research study, you will be asked to participate in an audio recorded cognitive interview to help in developing nutrition messages/nudges for students to encourage healthy eating, budgeting, skillful food and stress management behaviors. The audio recording of the cognitive interview will be destroyed after data transcription and analysis is completed. Your total time commitment will be approximately 45 minutes. For your participation, you will receive a monetary compensation of $ 10.00.

If you change your mind about participating, you can withdraw at any time during the study by requesting that the interview end. Your participation is completely voluntary. Your decision about whether or not to participate or to stop participating will not jeopardize your future relations with Auburn University, the Department of Department of Nutrition, Dietetics, and Hospitality Management.

Any data obtained in connection with this study will be maintained confidentially. Information collected through your participation may be used to fulfill an educational requirement, published in a professional journal, and/or presented at a professional meeting.

If you have questions about this study, please contact Dr. Onikia Brown at onbrown@auburn.edu or (334) 844-3161.

If you have questions about your rights as a research participant, you may contact the Auburn University Office of Research Compliance or the Institutional Review Board by phone (334)-844-5966 or e-mail at IRBadmin@auburn.edu or IRBChair@auburn.edu.

HAVING READ THE INFORMATION PROVIDED, YOU MUST DECIDE IF YOU WANT TO PARTICIPATE IN THIS RESEARCH PROJECT. IF YOU DECIDE TO PARTICIPATE, THE DATA YOU PROVIDE WILL SERVE AS YOUR AGREEMENT TO DO SO. YOU WILL BE GIVEN A COPY OF THIS LETTER.

Participant's Signature Date	Investigator obtaining consent Date
Print Name	Printed Name
	Principle Investigator Date
	Printed Name

The Auburn University Institutional Review Board has approved this document for use from.... to..... Protocol #....

The Auburn University Institutional Review Board has approved this Document for use from 07/28/2017 to 08/18/2018 Protocol # 16-319 EP 1608

AUBURN UNIVERSITY

COLLEGE OF HUMAN SCIENCES

Department of Nutrition, Dietetics,
and Hospitality Management

(NOTE: DO NOT AGREE TO PARTICIPATE UNLESS AN IRB APPROVAL STAMP WITH CURRENT DATES HAS BEEN APPLIED TO THIS DOCUMENT.)

INFORMED CONSENT

for a Research Study entitled

"Food Assistance Nudges"

We invite you to participate in a research study to evaluate the effectiveness of text delivered nudges/messages to create awareness of food assistance resources and to modify eating behavior, shopping habits and stress management behaviors of Auburn University students. Dr. Onikia Brown and Dorcas Mukigi of the Department of Nutrition, Dietetics, and Hospitality Management, Auburn University are conducting this study. You are invited to participate because you are a student at Auburn University.

Your participation is completely voluntary. If you decide to participate in this research study, you will be asked to complete an electronic survey that will take about 10 minutes to complete at the beginning and at the end of the study. You will be randomly assigned to the intervention or control group. The intervention group will receive text delivered nudges/messages 3 times a week for 7 weeks, and the control group will receive one email containing all nudges at the end of the study. For your time, a check of $ 5.00 and $ 10.00 will be mailed to you at the beginning and at the end of the study, respectively.

There are minimal foreseeable risks in this study. Your participation will contribute in understanding the effectiveness of text delivered nudges/messages in creating awareness of food assistance resources and modifying the eating behavior, shopping habits and stress management behaviors of college students.

If you change your mind about participating, you can withdraw at any time during the study by simply closing the browser or replying "stop" if you no longer wish to receive text messages. Your decision about whether or not to participate or to stop participating will not jeopardize your future relations with Auburn University, the Department of Nutrition, Dietetics, and Hospitality Management.

Any data obtained in connection with this study will remain anonymous. Information collected through your participation may be used to fulfill an educational requirement, published in a professional journal, and/or presented at a professional meeting.

If you have questions about this study, please contact Dr. Onikia Brown at onbrown@auburn.edu or (334) 844-3161.

If you have questions about your rights as a research participant, you may contact the Auburn University Office of Research Compliance or the Institutional Review Board by phone (334)-844-5966 or e-mail at IRBadmin@auburn.edu or IRBChair@auburn.edu.

HAVING READ THE INFORMATION PROVIDED, YOU MUST DECIDE WHETHER OR NOT YOU WISH TO PARTICIPANT IN THIS RESEARCH STUDY. YOUR SIGNITURE INDICATES YOU WILLINGNESS TO PARTICIPATE. A COPY OF THIS FORM WILL BE GIVEN TO YOU TO KEEP.

Participants signature Date	Investigator obtaining consent Date
Printed Name	Printed Name
	Principal Investigator Date
	Printed Name

The Auburn University Institutional Review Board has approved this Document for use from 11/29/2017 to 08/18/2018 Protocol # 16-319 EP 1608

APPENDIX B

Recruitment Materials

Dear student,

You are invited to participate in research study whose purpose is to develop nutrition messages/nudges for students to encourage healthy eating, budgeting, skillful food and stress management behaviors. The study is being conducted by Dr. Brown and Dorcas Mukigi from the Department of Nutrition, Dietetics, and Hospitality Management, Auburn University. You are invited to participate because you are a student at Auburn University and are age 19 or older.

Your participation is completely voluntary. If you decide to participate in this research study, you will be asked to participate in an audio recorded cognitive interview. Your total time commitment will be approximately 45 minutes. For your participation, you will receive a monetary compensation of $ 10.00.

Thank you so much,

Sincerely,

Onikia Brown, Ph.D.
Dorcas Mukigi


HUNGRY?
Struggling to make ends meet?
We want to hear your story.
Participants will be offered a $20 Kroger gift card.
We are seeking to understand the experiences of food insecure college students through an interview.
TO SCHEDULE AN INTERVIEW, EMAIL KATE.THORNTON@AUBURN.EDU
The Auburn University Institutional Review Board has approved this Document for use from 11/20/2015 to 09/19/2017 Protocol # 16-319 EP 1608

APPENDIX C

Surveys

COLLEGE STUDENT FOOD SECURITY EVALUATION

1. **Gender** [ ] Female [ ] Male [ ] Other: _____
2. **Age: _____**
3. **Marital status [ ]** Single [ ] Married [ ] Divorced/separated [ ] Widowed
4. **Where do you live?**

   [ ] On Campus [ ] Off-campus → [ ] Alone [ ] With roommates [ ] With spouse/partner [ ] With parents/relatives
5. **How many children under 18 live in the same home with you? _____**
6. **Ethnicity (Mark one)**

   [ ] African American/Black [ ] Hispanic/Latino [ ] White/Caucasian [ ] Asian [ ] Pacific Islander [ ] Native American [ ] Mixed-race [ ]Other_____
7. **What is your student enrollment status?**

   [ ] Full-time [ ] Part-time [ ] Other (specify):_____
8. **What is your classification?**

   [ ]Freshmen [ ] Sophomore [ ] Junior [ ] Senior [ ] Masters [ ] PhD
9. **Which of the following programs do you participate in? (Mark all that apply)**

   [ ] Work study [ ] Federal Perkins loan [ ] Federal Pell Grant

   [ ] Student organizations [ ] Greek organization [ ] International students organization

   [ ] SNAP [ ] WIC
10. **Do you have a meal plan?**

    [ ] Yes [ ] No
11. **Where were you born?** [ ] Alabama [ ] Other state/Country _____
12. **In the last 12 months, I worried whether my food would run out before I got money to buy more.**

    [ ] Often true [ ] Sometimes true [ ] Never true [ ] I don't know
13. **In the last 12 months, the food that I bought just didn't last, and I didn't have money to get more.**

    [ ] Often true [ ] Sometimes true [ ] Never true [ ] I don't know
14. **In the last 12 months, I couldn't afford to eat balanced meals.**

    [ ] Often true [ ] Sometimes true [ ] Never true [ ] I don't know

15. In the last 12 months, did you ever cut the size of your meals or skip meals because there wasn't enough money for food?

[ ] Yes [ ] No (skip # 16) [ ] I don't know (skip # 16)

16. (IF YES ABOVE) How often did this happen?

[ ] Almost every month [ ] Some months but not every month

[ ] Only 1 or 2 months [ ] I don't know

17. In the last 12 months, did you ever eat less than you felt you should because there wasn't enough money for food?

[ ] Yes [ ] No [ ] I don't know

18. In the last 12 months, were you ever hungry but didn't eat because there wasn't enough money for food?

[ ] Yes [ ] No [ ] I don't know

19. In the last 12 months, did you lose weight because there wasn't enough money for food?

[ ] Yes [ ] No [ ] I don't know

20. In the last 12 months, did you ever not eat for a whole day because there wasn't money for food?

[ ] Yes [ ] No (skip # 21) [ ] I don't know (skip # 21)

21. (IF YES ABOVE) How often did this happen?

[ ] Almost every month [ ] Some months but not every month

[ ] Only 1 or 2 months [ ] I don't know

22. Do you do any of the following to acquire food when you cannot afford to purchase it? (Check all that apply)

[ ] Food pantry/Bank [ ] Soup kitchen [ ] Go through dumpster

[ ] Other:_____ [ ] No

23. How is your health in general?

[ ] Very good [ ] Good [ ] Fair [ ] Bad [ ] Very bad

24. **How often do you participate in at least moderate physical activity?** (Examples of moderate physical activity: walking, ballroom dancing, bicycling < 10mph, water aerobics)

[ ] 0-3 times a week [ ] 4-7 times a week [ ] Daily

25. Height:_____ [ ] Weight: _____

26. **Do you work?** [ ] No [ ] Yes (_____ Hours per week)

27. What is your yearly income?

[ ] Less than $ 10,000 [ ] $ 10, 000 to 19,000 [ ] $ 20,000 to 39, 000 [ ] $ 50,000 or more

28. **Do you have credit card debt?** [ ] No [ ] Yes (total $ _____)

29. **What is your average living expense per month?**

[ ] $ 0-500 [ ] $ 501-750 [ ] $ 751-1000 [ ] $1,001-1500 [ ] $ >1,500

30. **How much of this budget do you spend monthly on _____**

a. **Housing (incl. utilities – electricity, water, gas, cable, and internet)**

[ ] $0-500 [ ] $501-750 o $751-1000 o > $1000

b. **Transportation (incl. car payments, car insurance, bus, and/or gas)**

[ ] $0-50 [ ] $51-100 [ ] $101-150 [ ] $151-200 [ ]> $200

c. **Food –**

Groceries [ ] $0-50 o $51-100 [ ] $101-150 [ ] $151-200 [ ] > $200

Take out/eating out [ ] $0-50 [ ] $51-100 [ ] $101-150 [ ] $151-200 [ ] >$200

d. **Entertainment (e.g., movies, drinks)**

[ ] $0-50 [ ] $51-100 [ ] $101-150 [ ] $151-200 [ ] > $200

e. Cell phone bill [ ] $0-30 [ ] $31-60 [ ] $61-90 [ ] $91-120 [ ] > $120

f. Shopping (e.g., clothes, shoes, household items)

[ ] $0-50 [ ] $51-100 [ ] $101-150 [ ] $151-200 [ ] > $200

31. **In the past year how much did you spend on a one-time large expense such as school books, laptop, or traveling?**

[ ] $0-350 [ ] $351-500 [ ] $501-750 [ ] $751-1000 [ ] > $1000

THE END

Thank you for participating!

COLLEGE STUDENT FOOD SECURITY SCREENER

The following questions are about food you have eaten in the last three (3) months.

32. I was worried the food I bought would run out before I got money to buy more.
    [ ] Often true [ ] Sometimes true [ ] Never true [ ] I don't know
33. The food that I bought just didn't last, and I didn't have money to get more.
    [ ] Often true [ ] Sometimes true [ ] Never true [ ] I don't know
34. I couldn't afford to eat balanced meals.
    [ ] Often true [ ] Sometimes true [ ] Never true [ ] I don't know
35. In have cut the size of your meals or skipped meals because there wasn't enough money for food.
    [ ] Yes [ ] No [ ] I don't know
36. I have eaten less than I should because there was no money for food?
    [ ] Yes [ ] No [ ] I don't know
37. I have been hungry but did not eat because there was not enough money for food.
    [ ] Yes [ ] No [ ] I don't know
38. I have lost weight because there wasn't enough money for food?
    [ ] Yes [ ] No [ ] I don't know
39. I have not eaten for the whole day because there wasn't enough money for food.
    [ ] Yes [ ] No

Student Classification

1. Which classification are you?
   [ ] Freshman
   [ ] Sophomore
   [ ] Junior
   [ ] Senior
   [ ] Graduate student

DEMOGRAPHIC INFORMATION

1. Please your name in the space provided below (needed for processing check)

   .....

2. Please type your university email address in the space provided below

   .....

3. Please type your cell phone number in the space below (needed for delivering Nudges).

   .....

4. How old are you?

   [ ] 18-24 years [ ] ≥25 years

5. Which classification are you?

   [ ] Sophomore

   [ ] Junior

   [ ] Senior

   [ ] Graduate student

6. What is your:

   Height (feet) _____ Weight (pounds)_____

7. What is your gender?

   [ ] Male

   [ ] Female

8. What is your race/ethnicity?

   [ ] African American/Black

   [ ] White

   [ ] Other .....

   [ ] Hispanic or Latino

   [ ] Alaskan Native

   [ ] Asian

   [ ] African

   [ ] Multi-Racial

RESOURCE AWARENESS AND UTILIZATION

1. Are you aware of any places on campus where you can receive supplemental food if needed?
   ☐ Yes ☐ No
2. Is there is a food pantry on campus?
   ☐ Yes ☐ No
3. [If yes display]. Have you ever used the on-campus food pantry or received free meals offered by the campus kitchens?
   ☐ Yes ☐ No
4. [If yes] How many times a semester do you get food from campus food pantry or Campus Kitchens?

   ☐ 1 time ☐ 2 times ☐ 3 times ☐ 4 times ☐ 5 or more times

5. Please tell us how you may feel should you ever need to receive food from the food pantry or Campus Kitchens?

	Strongly agree	Agree	Neither agree or disagree	Disagree	Strongly disagree
Encouraged					
Supported					
Satisfied					
Ashamed.					
Embarrassed.					
Loss of self respect					

6. Please tell us how likely you are to use the following resources to receive food assistance.

	Extremely likely	Moderately likely	Neither likely or unlikely	Moderately unlikely	Extremely unlikely
Ask parents, friends, relatives or partner to send money.					
Ask parents, friends, relatives to send/purchase food.					
Attend events serving free food.					
Borrow money.					
Dumpster dive.					

Go to off/on campus food pantry.					

FRUITS AND VEGETABLES SCREENER

INSTRUCTIONS

- **Think about what you usually ate the last one month.**
- **Please think about all the fruits and vegetables you ate last month. Include all that were**
    - **raw and cooked**
    - **eaten as snacks and at meal times**
    - **eaten at home and away from home (restaurants, friends, take-out) and**
    - **eaten alone and with mixed foods.**
- **Report how many times per month, week, or day you ate each food, and if you ate it, how much you usually had.**
- **If you mark "Never" for a question, follow the "Go to" instruction.**
- **Choose the best answer for each question. Mark only one response for each question.**

---

1. Over the last month, how many times per month, week or day did you drink **100% juice** such as orange, apple, grape or grapefruit juice? **Do not count** fruit drinks like Kool-Aid, lemonade, Hi-C, cranberry juice drink, Tang and Twister. Include juice you drank all mealtimes and between meals.
2. Over the last month, how many times per month, week or day did you eat **fruit?** Count any type of fruit- fresh, canned, and frozen. Do not count juices. Count all fruits you ate at mealtimes and for snacks
   2a) Each time you ate **fruit**, how much did you usually eat?
3. Over the last one month, how often did you **eat lettuce salad (with or without other vegetables)**
   3a) Each time you ate **lettuce salad**, how much did you usually eat?
4. Over the last one month, how often did you **eat French fries** or **fried potatoes?**
   4a) Each time you are **French fries,** or **fried potatoes,** how much did you usually eat?
5. Over the last month, how often did you eat **other white potatoes?** Count **baked, boiled** and **mashed potatoes, potato salad,** and **white potato that were not fried.**
   5a) Each time you ate **these potatoes,** how much did you usually eat?
6. Over the last month, how often did you eat **cooked dried beans?** Count **baked beans, bean soup, refried beans, pork** and **beans,** and **other bean dishes.**
   6a) Each time you ate **these beans,** how much did you usually ate?
7. Over the last month, how often did you eat other vegetables?

DO NOT COUNT: Lettuce salad, White potatoes, Cooked dried beans, Rice, Vegetables in mixtures such as sandwiches, omelets, casseroles, Mexican dishes, stews, stir-fry, soups, etc

COUNT: All other vegetables- raw, cooked, canned, frozen

7a) Each of these times that you **ate other vegetables**, how much did you usually eat?

8. Over the last one month, how often did you **eat tomato sauce**? Include tomato sauce on pasta, or macaroni, rice, pizza and other dishes.
   8a) Each time you ate **tomato sauce**, how much did you usually eat?
9. Over the last month, how often did you eat **vegetable soups?** Include tomato soup, gazpacho, beef with vegetable soup, minestrone soup, and other soups made with vegetables.
   9a) Each of these times that you **ate vegetable soup**, how much did you usually eat?

10. Over the last one month, how often did you **eat mixtures that included vegetables?** Count foods such as sandwiches, casseroles, stews, stir-fry, omelets and taco's.

SWEETENED BEVERAGE INTAKE SCREENER

1.On average, how often in the past month did you consume a non-diet, sugar-sweetened soft drink? (For example, Coke, Sprite, Dr. Pepper, Pepsi, Mountain Dew, Orange Crush, Mr. Pibb, 7-Up, Fanta, root beer)

Never or less than one per month ☐ 1-4 per month ☐ 2-6 per week ☐

1 per day ☐ 2 per day ☐ 3 per day ☐ 4 per day or more ☐

1 a). If you consumed any non-diet, sugar-sweetened soft drinks last month, what was the typical serving size you consumed?

I have not had a non-diet sugared soft drink in the last month ☐ 12-ounce can ☐

Restaurant glass or cup ☐ 20-ounce bottle ☐ 2-liter bottle ☐

2. On average, how often in the past month did you consume fruit drinks? (For example, Hawaiian Punch, Hi-C, Kool-Aid, Minute Maid, Ocean Spray cranberry juice cocktail, Snapple, Sunny Delight, Country Time Lemonade, etc.)

Never or less than one per month ☐ 1-4 per month ☐ 2-6 per week ☐

1 per day ☐ 2 per day ☐ 3 per day ☐ 4 per day or more ☐

2a). If you consumed any fruit drinks last month, what was the typical serving size you consumed?

I have not had a fruit drink in the last month ☐ 11.5-ounce can or less ☐

20-ounce bottle ☐ 64-ounce bottle ☐

3. Please select statement that best describes your thoughts

☐ "I have no plans to cut down the amount of sugared beverages I drink"

☐ "I have thought about cutting down on the amount of sugared beverages I drink and will probably do it in next 3 months"

☐ "I have recently made changes to cut down on the amount of sugared beverages I drink"

☐ I have already cut down on the amount of sugared beverages I drink and have kept this up for 6 months or longer"

MINDFUL EATING

Self-instruction for healthful meal-time behavior intention and self-regulation of healthful mealtime behavior

How often in the past three months had you:					
	Never	Sometimes	Regularly	Often	Always
Reminded myself that planning quick and simple meals is important					
Reminded myself that healthy meals do not require a lot of work					
Reminded myself to eat in moderation					
Told myself to allow room for an occasional treat food or dessert for just plain enjoyment					
Reminded myself to think about my beverage choices					
Told myself fruits and vegetables should be included in every meal					
Planned quick, easy and healthy snacks					
Selected beverages with health in mind					
Purposely added vegetables to meals and snacks					
Been flexible and sensible in food choices					

COHENS PERCEIVED STRESS SCALE

0 = Never 1 = Almost Never 2 = Sometimes 3 = Fairly Often 4 = Very Often

1. In the last month, how often have you been upset because of something that happened
2. In the last month, how often have you felt that you were unable to control the important things in your life?
3. In the last month, how often have you felt nervous and "stressed"?
4. In the last month, how often have you felt confident about your ability to handle your personal problems?
5. In the last month, how often have you felt that things were going your w a y .....
6. In the last month, how often have you found that you could not cope with all the things that you had to do?
7. In the last month, how often have you been able to control irritations in your life?.....
8. In the last month, how often have you felt that you were on top of things?..
9. In the last month, how often have you been angered because of things that were outside of your control?.....
10. In the last month, how often have you felt difficulties were piling up so high that you could not overcome them?

TEXT MESSAGE EVALUATION

1. Did you read the text messages?

   [ ] Yes [ ]No

2. How many text messages did you read?

   [ ] 0

   [ ] 1-7

   [ ] 8-14

   [ ] 15-21

3. Did you find the messages useful?

   [ ] Yes [ ] No

4. Which alternative mode of message delivery would you have preferred?

   [ ] Email

   [ ] Facebook

   [ ] Regular Mail

   [ ] Flyers

   [ ] Classroom setting

   [ ] Face-to-face

   [ ] Twitter

   [ ] Snap Chat

   [ ] Instagram

   [ ] An App

   [ ] iMovie

   [ ] Other ☐

5. How can we improve the Nudges?

   .....

   .....

APPENDIX D

Interview Guide

Cognitive Interview Guideline

1. Food insecure students will be asked to read a list of nutrition messages and express their thoughts, feelings, ideas when reading the messages and suggest alternative wording if needed.
2. The interviewer will use probes to ensure clarity of participant statements.

Lived Experiences Interview Guide

Table 1. Key Interview Questions
Can you tell me about the last time you were in a personal crisis because you didn't have enough food to eat?
What steps did you take to get food during this crisis?
How does being hungry affect what you do as a college student?
Is hunger a new experience for you since you came to college or is it something you've also experienced at other times in your life?
How do you think your academic studies would be different if you did not experience hunger?
Tell me how you plan and budget for your meals/what do you consider when you plan and budget for your meals?
Tell me about the last time you went shopping?
Is there any food item you wanted to buy but couldn't afford?
What does healthy eating mean to you? What are your healthiest and unhealthiest habits?