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Since the 1970s, the rates of overweight and obesity have increased among all age groups in the US. The greatest increase has been in young adults, including college aged students, placing them at risk for early onset chronic diseases and shortened lifespans. One potential cause of the increased rates of obesity is the rise in consumption of away from home foods, which are often high in calories, saturated fat, and added sugar. The Dietary Guidelines for Americans encourage people to eat more meals at home and to choose lower calorie meals and snacks while dining out. Two sources of away from home meals that often sell high calorie meals and snacks are fast food restaurants and vending machines. College students frequently consume foods from both.

Research suggests that the affordability or financial access of fast food meals and the availability of fast food restaurants are two factors that promote the consumption of fast food meals. However, it is not known what predicts fast food consumption among college students who can access fast food meals with their meal plans. Research also suggests that providing nutrition information at fast food restaurants can lead to a reduction in the average number of calories purchased there, but it is not known if providing nutrition information at vending machines will lead to a reduction in calories purchased by college students.

The purpose of this dissertation research was to identify factors associated with fast food consumption among college students and to test whether a particular strategy (i.e., providing nutrition information at the vending site) could change purchasing behavior among college students. The first study tested whether days on campus, financial access, and health consciousness were associated with the number of meals that college students obtained from fast food restaurants. In April 2013, a sample of 1246 students who were currently enrolled in a

UNCG meal plan completed an online survey in which they accounted for where they obtained their past week's meals. There was a positive association between financial access as measured by the amount of flex dollars on a student's purchased meal plan and the number of meals they obtained from fast food meals restaurants in the past week. There was a negative association between a student's level of health consciousness (i.e., monitoring calorie and fat intake and using nutrition labels) and the number of meals obtained from fast food restaurants in the past week. Specifically, a one-unit increase in level of health consciousness was associated with a 23% decrease in number of fast food meals. Exposure to fast food restaurants, as measured by the number of days spent on campus in the last week, was not associated with the number of meals obtained from fast food restaurants.

The second study tested the effect of a multi-component nutrition information labeling intervention at the vending site. In the fall of 2012, 18 UNCG residence halls (1 machine per hall) were randomly assigned to either a treatment or control condition. In the treatment condition, nutrition information was provided next to the vending machines, five snacks were identified on the sign as "Better Choice" items (i.e., relatively lower in saturated fat, sugar and calories compared to the other items in the machine) and a promotional email was sent to students living in those residence halls (n = 9 vending machines). In the control condition information was not provided at the vending machine and no email was sent to students living in those residence halls (n = 9 vending machines). Sales data were collected for 4 weeks before and 4 weeks during the intervention for each of the machines. At the end of the 8 weeks, the average number of calories and the proportion of Better Choice snacks sold per and post intervention was compared. No difference in either outcome was found.

The dissertation concludes with a discussion of strengths and limitations of both studies, and suggestions for next steps for programming and research

FOOD AWAY FROM HOME: PREDICTING FREQUENCY AND CHANGING SELECTIONS

by

Deirdre A Dingman

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Approved by

_____
Committee Co- Chair

_____
Committee Co- Chair

My father loved to solve the cryptoquotes in the Winston Salem Journal.

One day the solution was a Yiddish proverb that read:

"If a man is destined to drown, he will drown even in a spoonful of water."

It seems to me that the inverse must also be true.

If a man is destined to swim, even oceans cannot sink him.

I was meant to swim and my father always knew this. He knew this even as I pushed him away and traveled dangerous paths. He feared, he waited, he loved and I righted myself. He did not live to see this day, but he believed in his heart, that I would.

Thank you, Daddy.

I Love You.

Until we meet again, in the sweet bye n bye, Somewhere in Time.

APPROVAL PAGE

This dissertation has been approved by the following committee of the Faculty of The Graduate School at The University of North Carolina at Greensboro.

Committee Co-Chair _____
Mark R. Schulz

Committee Co-Chair _____
Kelly L. Rulison

Committee Members _____
David L. Wyrick

_____
Daniel L. Bibeau

_____
Sat N. Gupta

_____
Date of Acceptance by Committee

_____
Date of Final Oral Examination

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CHAPTER I

PROLOGUE

Statement of the Problem

In the US, the prevalence of obesity, as measured by Body Mass Index (BMI), has steadily increased from the 1970s to the 2010s, and in 2013, the American Medical Association declared obesity a stand-alone disease.[79] The prevalence of obesity (BMI >30) in persons aged 20 and older increased from 15% between 1976-80 to 35% in 2009-10.[1, 2] The prevalence of overweight (BMI between 25 and 30) was about 32% throughout this time period. In 2009-10, nearly 70% of adults were classified as either overweight or obese.[2] The American Medical Association's decision to classify obesity as a disease was meant to signify the importance of treating obesity itself not just the chronic diseases to which it contributes.

Although rates of obesity are lower among college age adults, the prevalence has increased at a faster rate among 18 to 29 year olds than any other group. In the 1990s, obesity in adults aged 18 to 29 increased at a faster rate than any other age group. For adults aged 18 to 29 the prevalence of obesity increased from 7.1% in 1991, to 12.1% in1998. This 70% increase was the highest of any other group. The next highest increase (50%) was in 30 to 39 year olds, followed by 48% in 50 to 59 year olds and 45% in 60 to 69 year olds, 34% in 40 to 49 year olds and 29% in those aged 70 or older.[78] The prevalence of obesity among traditional aged college students (i.e., those aged 18 to 24) is not available from nationally representative samples. However, in a longitudinal study that followed young adults for ten years, 18 to 20 year olds gained about 6 more pounds than 27 to 30 year olds.[3,80] On average college students gain 3 to 10 pounds between their freshman and senior year - weight that they do not shed later.[3]

Obesity during childhood and adolescence often leads to obesity in adulthood[5] and is associated with diabetes and hypertension in both young and later adulthood.[6] Morrell et al [7] recently found that 77% of college men and 54% of college women had at least one marker of metabolic syndrome (i.e., high blood pressure, high fasting blood glucose level, high triglycerides, abdominal obesity, or low HDL cholesterol). Metabolic syndrome increases the risk of diabetes and heart disease. Cheng et al[8] found that the association between obesity and diabetes was strongest for younger persons, and Olshansky et al suggest that the current level of chronic disease could result in shortened life expectancy for this generation of youth.[9] It is imperative that steps be taken to reduce both overweight and obesity among college students, due to the above noted health consequences.

Factors linking obesity and away from home foods

One driver of the increase in the prevalence of obesity may be the increase in the number of meals that children, adolescents and adults obtain from away from home sources (e.g., restaurants, vending machines)**.** Guthrie and collegues[10] found that calories consumed as meals away from home increased from 18% to 32% of a person's total calories in the years from 1977-78 to 1994-96. They speculated that the increase in consumption of meals away from home in turn, led to overconsumption of calories, sugar, saturated fat, and sodium, all of which the Dietary Guidelines established by US Departments of Agriculture and Health and Human Services [27] recommends Americans limit in their diets.

Notably, fast food meal consumption has increased in young adults. In one study, young adults aged 19 to 29 increased their restaurant and fast food consumption, by about 100% between 1977 and 1996 compared to adolescents (12 to 18) whose fast food consumption was unchanged during the same period. In 1994 -1996, adolescents consumed 21% of their calories from fast food and restaurant sources whereas young adults consumed 34% of their calories from

them suggesting that there may be an increase in fast food and away from home food consumption during the transition from adolescence to young adulthood.[3,81]

In addition to an increase in the number of meals obtained away from home, there has been an increase in the portion size and the amount of energy content of away from home foods. For example, Nielsen and Popkin[11] found both table service and fast food restaurants increased the portion size and calorie content of their soft drinks, hamburgers and french fries between 1977 and 1996. Newer research has shown that away from home foods contain large amounts of calories, fats and sugar, in some cases, more than half a day's worth of the amount of these items recommended by The Guidelines.[12,13]

Changes in portion size and macronutrient density (e.g., the amount of saturated fat, sugar, calories per gram of food) of meals from away from home along with increased away from home consumption, may have led to higher intake of calories, sugar and saturated fat than what is recommended for daily meal patterns.[27] This change may be associated with an increase in adverse health outcomes.[14-16] For example, Bowman and Vinyard[15] found that persons who ate at fast food restaurants on two days of dietary recall were twice as likely as those who did not consume fast food meals to have consumed higher than the recommended amount of saturated fat, total fat and sugar. In addition to, or perhaps because of macronutrient overconsumption, eating fast food meals has been linked to distal outcomes as well (e.g., body fatness, weight gain and BMI). **[14,17, 18-20]**

Away from home food consumption in young adults and college students

Young adults aged 20 to 39 consume a higher percentage of their calories from fast food restaurants than any other age group. They receive about 15% of their calories from fast food meals, compared to 11% for adults aged 20 to 59, and 6% for adults age 60 and older.[23] Studies of college students[24,25] show that most consume no less than one fast food meal a week and some

as many as six to eight. Excess consumption of fat, sugar and calories can occur with one fast food meal[10] and weight gain has been observed with as little as two fast food meals a week.[26] The frequency with which college students consume fast food meals places them at great risk for overconsumption of calories, saturated fats and sugar, weight gain, obesity and chronic diseases.

In addition to fast food restaurants, vending machines are another source of away from home foods that may lead college students to consume higher than the recommended amounts of calories, saturated fats and sugar**.** Traditional vending machines contain items that the Dietary Guidelines for Americans[27] suggest all persons limit (e.g., candy, chips, baked goods, sodas, sports drinks) because they are high in solid fats and added sugars, which increase calorie but not nutrient density. Vending machine snacks are responsible for 20% of excess calorie consumption in adults, but there is a limited amount of empirical evidence on frequency of vending snack consumption for college students. [28] One study found that 16% of college students consume one or more vending snacks each day, [34] which higher than high school students who consume on average 1 vending snack per week.[33] This information suggests that vending behavior also increases from adolescence to young adult hood.

Correlates of fast food and vending snack consumption

One factor that may be related to fast food meal consumption is living or going to school near fast food restaurants. Previous research has documented an association between living near fast food restaurants and adverse health outcomes, such as obesity and excess body fat.[18,29] For example, Maddock[22] found a positive association between state level obesity prevalence and both the number of persons per fast food restaurant and the number of restaurants per square mile within each state. One potential pathway for these associations is that nearness to fast food restaurants leads to exposure, which leads to the consumption of fast food meals, which in turn leads to excess caloric intake and adverse health outcomes. Though young adults and college

students in particular consume a high amount of fast food, this particular causal path has not been tested in college attending students.

Another factor that may be related to fast food meal consumption is the concept of value and the low cost of meals.[30,31] College students surveyed by Morse and Driskell[30] reported eating at fast food restaurants because they were "inexpensive and economical." In addition, college students who participated in focus groups noted that having fast food restaurants included on university meal plans was one reason that they dined at them.[31]

A third factor that may be related to fast food consumption is a college student's level of health consciousness, which includes behaviors such as monitoring calories and fat and using nutritional labels.[32] Though not specific to fast food, Ellison et al[32] found that students and non-students with higher levels of health consciousness purchased lower calorie items compared to other patrons.

With regard to snacking, the presence of vending machines on college campuses may increase snack consumption for college students in the same manner as it has for high school students.[33] For example, Neumark-Sztaineret et al.[33] found that as the number of machines at a school increased, so did the number of snacking occasions per week. It is also likely that nearness to vending machines (e.g., in one's residence hall or classroom building), is associated with snacking.

The US Governments nutrition information approach: limitations

To address the increase in consumption of calories and certain macronutrients among all age groups, the US Government began implementing educational and labeling strategies in 1990, but these strategies have some limitations. In 1990, the government passed the Nutrition Labeling and Education Act, which mandated that food manufacturers place standardized nutrition information on all packaged products. The premise of the law was that consumers would

read the labels, consider the dietary guidance promulgated by the government (i.e., The Dietary Guidelines for Americans[27]), and make food choices that would align with this dietary guidance. The legislation also mandated that the FDA provide an educational component, which includes instructions on reading nutrition labels.

One potential limitation of the Nutrition Labeling and Education Act is that it uses a cognitive approach to behavior change. At the individual level where people make decisions about which foods to purchase, behavior is not so simple to change. Multiple cognitive, affective and social processes guide food decisions.[36-39] One cognitive process involves the use of reading and math skills. The nutrition information provided on labels, in grams and percentages, requires an above average level of numeracy and research has shown that many Americans cannot interpret the labels.[38] In addition, Nutrition Facts Panels where the information is placed, do not necessarily trigger health relevance, and the strategy does not account for the irrational consumer.[40] In economic theory, a rational consumer uses available information to weigh the pros and cons of a behavior, with the goal of maximizing pleasure and minimizing pain. The irrational consumer, on the other hand, focuses more on the pleasure (e.g., taste) especially when the consequence of the choice (e.g., heart disease) is far removed. In addition, the irrational consumer is time variant, wavering in his decision, especially as distal consequences become proximate (i.e., as he or she ages).[41] This is also called present bias, and is a challenge for many, as other factors related to food choice (e.g., taste, cost, preference, social norms) often take precedence at the point of decision making.[41,42]

There are subpopulations that benefit from the food labels. In studies of individuals, mostly women, who have at least a high school education and some nutrition knowledge, the Nutrition Facts Panel has been found to improve dietary behavior (making choices that align with recommended daily intakes). [38,43] Also, in a study involving college students, the belief that

nutrition information was important predicted label use, and label use increased the chance that diet recommendations were met.[44]

A second potential limitation of the Nutrition Labeling and Education Act is that it exempts away from home foods. Without nutritional information in restaurant and vending settings, consumers lack access to the main component of rational decision-making: information. Wooten and Osborne[45] found that in 2004, a majority of fast food chain restaurants had information available on their websites, but not at the point of purchase (i.e., where one selects and pays for the item). A lack of information at the point of purchase makes it more difficult for consumers to accurately estimate calorie content and this can lead them to consume excess calories.[46] In addition, Burton and colleagues found that, consumers will change to lower fat or calorie meal selection when they are provided nutrient information that disconfirms expectations (e.g., a salad that is high in fat).[47]

The US Governments nutrition information approach: improvements

The provision of nutrition information in the restaurant and vending setting may help reduce the caloric over consumption that occurs with away from home dining. [47-52] [53-55] [56,57] For example, Wisdom et al[57] found that customers who used menus that contained calorie amounts purchased, on average, 60 calories less than those using a standard menu. In response to this and similar findings, the Institute of Medicine recommended nutrition labeling on restaurant menus and menu boards in 2009, and as early as 2008, several state and local governments mandated menu disclosures.[58] The results of the state and local policies are promising with both a New York City and a King County Washington law leading to fewer mean calories purchased after the legislation was enacted.[48,59]

Evidence on the use of nutrition labeling at the vending site is limited to a few field studies.[60-63] Researchers have tested the effect of providing nutrition information and using

symbolic labels, as well as the effect of manipulating availability and price of different snacks. Though some selection behavior improved when labels or information was introduced, [60, 64, 48] the greatest effect was seen when the availability of low calorie or low fat snacks was increased or the price of lower fat snacks was reduced.

The US Congress has passed a national menu labeling law, which addresses the gap in information for away from home foods, but it mandates a disclosure standard that has limited research support. [65] According to the law, chain restaurants and vending companies must post calorie information and a contextual statement. The statement suggests that some adults require 2000 calories a day. In general, experiments and field studies that used a similar contextual statement did not find evidence that the statements were effective in reducing the intention to purchase calories or the actual purchase of less calories.[70] In one exception, Roberto el al[71] found that adults who were given menus with calorie information and a recommended daily intake statement did consume less calories outside of the study meal, suggesting that the information may help with overall daily caloric regulation.

One way to increase the effect of the law might be to follow recent nutrition labeling recommendations by the Institute of Medicine.[37] The Institute of Medicine suggests the use of a standardized label format, which can reduce the cognitive burden of information processing. By using an interpretive label, consumers can easily identify products that are high or low in calories, salt, saturated fat and added sugars. The Institute of Medicine speaks directly to updating packaged food labels (due to their limited effectiveness), and their suggestions would apply to vending snacks, and could be applied to menu labels.

The Institute of Medicine and others have suggested specific ways to make labels more interpretive and beneficial to consumers.[66-68] The Institute of Medicine recommends a system that provides 0 to 3 stars depending on the amount of saturated fat, salt and added sugar in a

serving,[29] while others have suggested using the multiple traffic light.[69] The traffic light label highlights the number of calories, saturated fat, sugar and sodium by putting them in individual circles. The circles can be red, amber or green. If a product is high in a nutrient most people need less of (e.g., sugar) the number of that nutrient (in grams or milligrams) is placed in a red circle. Both of these label formats allow people to determine quickly, which item is high or low with regard to macronutrient criteria. One of the main improvements is that these labels do not require high numeracy as red would always be used to warn that the product is high in a nutrient that is detrimental in excess, and if using the point system, a 3-point product is more in line with dietary recommendations than a 0-point product.

The use of interpretive labels in the restaurant setting may lead to a reduction is excess consumption of calories. [32,72-75] Research suggests that menus that highlight or rank entrees as "low calorie " or "high calorie" are easier for customers to understand and apply when making choices than providing calorie amounts and calorie statements .[32,76] Ellison et al [32] used the traffic light system to label entrees in a university restaurant and found results similar to those for packaged foods. Customers preferred the traffic light format to a menu that listed the number of calories without qualifying them as high, moderate or low, and chose lower calorie items when using the traffic light menus compared to the calorie only menus. Thorndike et al[77] also found that by using color codes based on macronutrient content (e.g., the amount of saturated fat, calories) sales of items that were lower in fat and calories increased.

Though a great deal of research has been conducted on restaurant menu labeling, no such body of evidence exists for vending machines. The FDA noted this gap in the research with its 2011 regulatory impact analysis,[28] and the gap remains. Due to the availability of vending machine snacks on many college campuses, strategies using nutrition information labeling should

be explored for their potential to reduce the risk of students consuming high amounts of calories, saturated fats and other nutrients that are harmful in excess.

Summary

In summary, there have been increases in obesity in every age group within the US over the last 40 years. An increase in consumption of away from home foods, which are high in calories, saturated fat, and added sugar, is likely one of the drivers of the rise in obesity rates. On average, Americans of all ages eat out more often than they did 40 years ago and the portion size of these meals has increased. Young adults and college students specifically are frequent consumers of fast food meals. Overweight and obesity in youth and young adults puts them at unique risk for early onset diabetes and heart disease, which may lessen their life expectancy. Taking note of population wide overconsumption of calories and other macronutrients, the US Government passed the Nutrition Labeling and Education Act, intended to assist consumers in making choices that align with dietary guidance. Noting failures of the main output of the law, the Nutrition Facts Panel, as well as a changing food environment, the government has proposed laws that would update and expand nutrition labeling. The current body of research may lead to revisions in restaurant menu labeling formats, but there has not been a similar press for revisions in vending labeling.

College students and young adults obtain more meals from fast food restaurants than other populations and engage in frequent snacking. This may put them at risk for obesity and adverse health consequences. Several studies have noted that being near to fast food restaurants and the value of the meals offered may predict the frequency with which people obtain meals from them. However, we do not know what predicts the number of meals college students obtain from fast food restaurants when they can access them with their meal plan. In addition, we do not know if nutrition information at the vending site can change purchasing behaviors in college students.

The goal of this dissertation research is to increase knowledge on both of these important dietary health behaviors. The results of these studies can be used to predict whether different strategies may be effective at reducing the risk of overweight and obesity in college students.

Dissertation Studies

Due to a high level of exposure to fast food restaurants and vending machines, college students are at risk for caloric overconsumption and its consequences, however the extent to which this access promotes fast food consumption is unknown. In addition, the extent to which nutrition labeling at college vending machines will alter vending purchases by college students is unknown. These gaps will be addressed with two separate studies.

Study 1: Factors Related To the Consumption of Fast Food Meals among College Students on a Meal Plan

University settings may provide easy access to numerous fast food restaurants. For example, the University of North Carolina at Greensboro provides access to fast food restaurants by allowing students to purchase meals from 10 on campus and 3 off campus fast food restaurants with their meal plan flex dollars. This arrangement is similar to other large or mid-sized universities, such as The Pennsylvania State University, the University of Tennessee, and the University of Michigan. The body of research that connects fast food restaurants with macronutrient excess, weight gain, and obesity suggests that college students' proximity to the restaurants, the number of restaurants within a certain geographical radius (i.e., fast food clusters) and the low cost of meals at these fast food restaurants are among the main drivers of fast food meal consumption. Research on primary schools and children and home environments and adults helped to establish this link. Because many college campuses provide students with fast food restaurant access, it is important to explore predictors of the number of meals obtained from them in this population specifically.

Objectives: Study 1 tests whether the number of fast food meals obtained from fast food restaurants is associated with days on campus, financial access, or health consciousness among college students. *Participants and Methods:* The study took place in April 2013, at the University of North Carolina at Greensboro. Students who were currently enrolled in a meal plan were invited to participate in an online survey ($N = 1246$). Students reported the total number of meals they had eaten in the previous week and where they had obtained the meals. Students also answered questions that indicated how frequently they spent time on campus, the amount of flex dollars they had on their meal plan, and their level of health consciousness. *Data Analysis*: The key dependent variables were the number of meals students obtained from fast food restaurants in total and on and off campus. Analyses controlled for other factors that could be related to the number of fast food meals obtained (e.g., race, sex, stress level) and used negative binomial regression to test whether days on campus, financial access, and health consciousness were associated with the dependent variables. *Hypotheses:* The first hypothesis was that students who spent more time on campus and students with more flex dollars on their purchased meal plan would obtain a greater total number of meals from fast food restaurants than other students. The third hypothesis was that health consciousness would be negatively associated with the number of fast food meals obtained. *Results:* Exposure, operationalized as the number of days spent on campus, was not associated with the number of fast food meals obtained. Financial access, operationalized as the amount of flex dollars on a purchased plan, was positively associated with the number of fast food meals obtained in total and on and off campus. A student's level of health consciousness was inversely associated with the number of meals obtained from fast food restaurants on campus, off campus and in total.

Study 2: Does Providing Nutrition Information at Vending Machines Reduce Calories Per Item Sold?

With access to vending snacks in their residence halls, college students are one group who stand to benefit from labeling at the vending site, but their use of information at the residential vending site has not been studied. The existing body of literature on nutrition labeling is predominantly restaurant or packaged food based, but it provides insight into which strategy might work best in this setting. Nutrition labeling has the potential to reduce excess calorie, saturated fat and sugar consumption associated with traditional vending snacks, and therefore it is important to test a promising strategy, especially in this at risk population.

*Objectives***.** Study 2 tests the effect of providing nutrition information and interpretive labels at the vending site in college residence halls. *Participants and Methods:* The study took place at the University of North Carolina at Greensboro during October and November of 2012. Eighteen residence halls containing one vending machine each were randomly assigned to either a treatment condition - in which nutrition information was posted, *Better Choice* labels were applied and residents were sent an email promoting the use of nutrition information to make vending snack choices - or to a control condition. Sales data were collected for a total of 8 weeks. The first four weeks of data collection occurred during a baseline period (pre intervention) under which the treatment package was not in place. The second four weeks of data collection occurred during a post intervention period during which all elements of the treatment were in place for the treatment machines. *Data Analysis*. Summary measures were used such that each machine had a pre and post intervention measure on the dependent variables. The dependent variables were the average number of calories sold per snack per week and the proportion of snacks labeled as *Better Choice* sold per week. A repeated measure ANOVA with one between and one within factor was used to test for a intervention effect which would be substantiated by a

significant interaction between condition and time. *Hypotheses.* There would be a reduction in the average amount of calories purchased in the treatment condition and an increase in the purchase of snacks with the interpretive label. *Results.* There was not a significant interaction for either dependent variable. Providing nutrition information, education and labeling did not change the purchasing behavior of this population.

The results of these two studies highlight possible next steps in research as well as in addressing the risk of overconsumption and obesity especially as it pertains to college students and college campuses. With regard to fast food restaurants, previous research suggests that the density of fast food restaurants leads to an increase in the consumption of fast food meals. Our study did not support this link, however it is possible that our operationalization of exposure did not capture the risk. A future study comparing the number of meals obtained from fast food restaurants among students attending campuses with varying levels of fast food density may better answer this research question. In the meantime, adjusting the ratio of venues, such that there are a greater number that offer low calorie, high nutrient options than high calorie, low nutrient options makes sense. We did find that level of health consciousness was negatively associated with the number of meals obtained from fast food restaurants. This individual factor may be modifiable factor through wellness programming and health communications. The results from the vending study did not support the use of nutrition information, labeling and promotion, but this may be due to study design or implementation fidelity. There is a need for research on vending labeling and an important next step may be to assess consumers' knowledge pertaining to calorie and macronutrient content of vending snacks, as well as preferences regarding nutrition displays.

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CHAPTER II

FACTORS RELATED TO THE NUMBER OF FAST FOOD MEALS OBTAINED BY COLLEGE MEAL PLAN STUDENTS

Abstract

Objectives: This study tested whether days on campus, financial access, and health consciousness were associated with the number of meals that college students obtained from fast food restaurants. **Participants and Methods:** In April 2013, we invited all students currently enrolled in a meal plan to participate in an online survey ($N = 1246$). We asked students to report the total number of meals eaten in the past week and where they obtained them. **Results**: We used negative binomial regression and found that the number of meals obtained from fast food restaurants was positively associated with financial access and negatively associated with health consciousness. We did not find an association between days on campus and the number of meals obtained from fast food restaurants. **Conclusions:** Increasing levels of health consciousness and reducing access to fast food restaurants through flex plans may reduce college students' consumption of fast food.

Key words: college students, fast food, meal plans, obesity

Introduction

Compared to other adults, young adults (aged 20 to 39) consume the most fast food.[1] Young adults obtain about 15% of their calories from fast food meals, whereas adults between the ages of 40 and 59 obtain 10.5% of their calories from fast food meals, and those aged 60 and older only 6%.[1] Studies specific to college students, many of whom are in

the 20 to 29 age group, show that most consume at least one fast food meal a week[6] and some consume as many as six to eight.[7] In one Vermont study, college students ate fast food 70% more often than non-college attending adults within the same community.[8]

High rates of fast food patronage can be problematic because the consumption of fast food meals has been associated with a diet that is high in calories, saturated fat, sugar, and sodium,[9] as well as body fatness, weight gain and increased BMI.[5,10,11] The link appears to be a lack of compensation for the high calories consumed from the restaurant meals. A typical fast food meal contains more than 800 calories,[12] which for most adults, exceeds 30% of their daily calorie needs (i.e., if a person ate 3 times a day and required 1800 to 2000 calories a day, they would consume 400 to 600 extra calories because they did not adjust their later intake).[13] For example, a study of adolescents found that when they ate fast food, they did not compensate for the excess calories later in the day and had a net increase in calories, saturated fat, and sugar compared to days that they did not eat fast food meals.[14] Gerend[6] found that both male and female college students ordered fast food meals that were in excess of 900 calories when they ordered from an online menu. It is possible that college aged students will not make caloric compensations after eating fast food meals.

Although frequent consumption of fast food meals by college students appears to put them at risk for obesity, there are gaps in our knowledge of what predicts fast food consumption among college students. One body of research suggests that proximity to the restaurants and geographical density of the restaurants is a main driver of fast food meal consumption.[5,10,11] Research on primary schools and children[15] and home environments and adults[16] helped to establish this link. It is highly plausible that the relationship or mechanism of effect exists for college students because of their proximity to fast food restaurants while on campus, but empirical studies are lacking in this particular population.

Being in close proximity to one or more fast food restaurants in a home or school environment and the ratio of fast food restaurants to venues selling less calorically dense foods are environmental factors that may contribute to fast food meal consumption and obesity. Bonne-Heinomen et al[16] found a positive relationship between the number of fast food restaurants within a .5 mile radius of a person's home and the number of times a person had eaten at a fast food restaurant in the past week, while others have found that nearness to fast food restaurants is associated with weight gain and percent body fat.[15] The ratio of fast food restaurants per person[17] and per outlet selling less calorically dense items (e.g., full service grocer)[18] have been positively correlated with obesity rates.

The theoretical pathway suggested by the above studies excludes an important component. The studies suggest that proximity leads to *consumption* which leads to weight gain which leads to body fatness and obesity. However, the link between proximity and consumption is indirect and a more complete conceptual path would include exposure. In other words, proximity leads to exposure, which increases the likelihood of fast food meal consumption, and the downstream consequences (e.g., weight gain) empirically noted. A home or school environment containing fast food restaurants provides a repeated dose of that exposure and therefore, people living or learning in close proximity to one or more fast food restaurants are at risk for obesity.

Another factor that has been associated with the number of fast food meals consumed by people in general and college students specifically is the financial accessibility of fast foods. The affordability of foods is associated with meal choice and foods sold from fast food outlets tend to contain ingredients that are cheaply available such that meals sold there are also inexpensive.[19] However, fast food access through meal plans is a newer phenomenon.[20] Driskell[7] found that cost was one of the main factors influencing dining choice in a sample of college students, and

college students interviewed by Nelson et al[20] noted that the low cost of meals as well as access through meal plans were reasons to dine at fast food restaurants. Nelson et al[20] did not quantitatively examine the use of meal plan dollars, however a recent study regarding secondary schools found that students enrolled in school lunch programs that accept debit cards consumed higher calorie diets than those which did not.[21] College meal plans offer similar pre-paid cards, which allow students to pay for a fast food meal with a swipe.

'Flex dollars' as external meal allowances are sometimes called, marry two of the most prominent factors related to fast food consumption, cost and convenience,[7,22] and are available at many colleges. The campus where the current study was conducted provides access to 6 on campus and 2 off campus fast food restaurants and allows students to purchase meals from them with their meal plan flex dollars. This arrangement is similar to other large or mid-sized universities. These university meal plans typically include a fixed number of unlimited dining hall meals, per week or semester, and varying degrees of flex dollars. It is possible to purchase a meal plan that does not include any prepaid dining hall meals. Flex dollars can be spent in the dining hall or at participating restaurants on or near campus. Flex dollars are a means of financial access to fast food meals and may be a factor related to consumption of them for college students. To our knowledge, no studies have examined access to fast food specifically through university meal plans and the amount of flex dollars on university meal plans.

A third factor that may be associated with the number of fast food meals that college students and other adults consume is individual level of health consciousness, or how much a person adheres to dietary guidance on limiting calories and other nutrients that may be harmful in excess (e.g., saturated fat, added sugar).[9] Ellison et al [23] found that adults, including college students, who are health conscious (i.e., limit fat, calories and regularly read food labels) are less likely to consume high amounts of calories at restaurants. It is possible that health conscious

people would also limit their consumption of fast food meals as a recent national survey found that 86% of adults thought food served at fast food restaurants was either "not too good for you," or "not at all good for you."[24]

The goal of our research was to test whether the number of fast food meals obtained within the last week was associated with: (1) exposure to fast food restaurants (assessed by how often a student is on campus), (2) financial access (the amount of flex dollars on a purchased meal plan), or (3) the students' level of health consciousness.

We hypothesized that students who spent more time on campus and students with more flex dollars on their purchased meal plan would obtain a greater total number of meals from fast food restaurants than other students. By contrast, we hypothesized that students with higher levels of health consciousness would obtain fewer meals from fast food restaurants than other students. With regard to exposure and financial access, we expected these to be associated with fast food meals obtained from on campus restaurants. We did not expect exposure or financial access to influence fast food meals obtained off campus because we expected that both factors (i.e., a cluster of restaurants and meal plan access) were unique to the campus environment. To test these hypotheses, we analyzed total fast food meals, on campus fast food meals and off campus fast food meals separately. (As per the literature, [2-5], we include pizza restaurants in the category of fast food.)

Methods

Subjects and Procedures

This study took place on the campus of a large, southeastern public university with a 2012 enrollment of over 18,000 students. The majority of students on the campus are female (65%) and white (61%), with an additional 23% of students identifying as black, and 16% as another

race or ethnicity (Hispanic, American Indian, Asian, multi-racial). Twenty four percent of enrolled students live in campus housing.

The university provides access to several food venues that accept meal plan flex dollars. This includes 6 on campus fast food restaurants, 2 off campus fast food restaurants, 5 other on campus venues (e.g., the university dining hall, convenient stores, mini-market) and one off campus sit down/ table restaurant. Before beginning the study, the research team received approval for all study materials and methods from the university's internal review board.

At the start of the second week of April 2013, we invited students currently enrolled in a university meal plan to complete a brief, web-based survey ($N = 5441$). The survey was available for 3 weeks and as an incentive, students could enter a drawing for 1 of five $100 gift cards. We received 1246 surveys (24% response rate). The response rate by meal plan type was similar to rates of meal plan enrollment (e.g. 32% of meal plan students were enrolled in the unlimited dining hall plan and 29% of the students who completed the survey had the unlimited meal plan). The main purpose of the survey was to identify where the students obtained the meals that they consumed the week before, therefore, we excluded 191 persons who did not provide any venue information about their meals. We included only cases where the student recorded at least 1 meal per day and no more than 10 meals per day (i.e., a total of 7 to 70). This led to the removal of 82 additional cases. Our final sample size for analysis was 973. The majority of respondents were female (81%), self-identified as white (54%), black (31%), or Latino, Asian, and other (15%), were full time students (97%), and lived in campus housing (81%). The majority of students were 18 (15%), 19 (30%), 20 (25%) and 21 (16%) with a range of 18 to 64.

Measures

Dependent Variables. We asked students to report the number of breakfast, lunch, dinner, and other meals they had eaten in the past 7 days, not including times when they only had a beverage.

Students were then asked follow up questions about how many of these meals came from each of nine different venues. This study focused on two venues: "fast food place that serves mostly fried foods, burgers or chicken",[3,16] and "pizza restaurant with delivery or counter service."We created 3 variables to indicate the number of fast food meals obtained in total, on campus and off campus.

Predictor Variables. We hypothesized that exposure, financial access, and health consciousness would be associated with the number of meals obtained from fast food restaurants.

Number of Days on Campus. We asked students "During the past 7 days, how many days did you spend time on campus (0 to 7 days)? This number captures their exposure to fast food restaurants on campus.

Number of Dollars on the Meal Plan. We operationalized financial access as the number of flex dollars on a purchased meal plan, which ranged from $100 to $1050 across nine available meal plans. We rescaled this variable as hundreds of dollars (i.e., 1 = $100).

Health Consciousness. We operationalized health consciousness using a modified version of Ellison's health consciousness scale.[23] The original scale contained three items. It asked respondents to rate how much each of 3 statements is like them (i.e., "I try to monitor the number of calories I eat in a day," "I try to avoid high levels of fat in my diet," and "I spend time looking at nutritional labels when shopping for my food.") Due to recommendation for Americans to specifically limit saturated fat intake,[9] we added one item, "I try to avoid high levels of saturated fat in my diet." Responses ranged from 0 "not at all like me," to 3 "exactly like me." We averaged all four health consciousness items ($\alpha = 0.88$).

Control Variables. To examine financial access specific to the meal plan flex dollars, we controlled for income and asked students how many hours they worked each week for pay ("none," "10 or less," "11 to 20," "21 to 32," "more than 32"). We recoded work hours at the

mean (i.e., 0 = 0, 1 = 5, 2 = 15, 3 = 26, 4 = 33) and used it as an interval variable. To examine the amount of flex dollars, separate from other factors that may be related to the meal plans, we included variables indicating the number of years a student had been enrolled at the university, the number of dining hall meals (non-flex) included on their meal plan (i.e., meal allowance) and whether or not the student lived on campus. We asked students the number of years they had been enrolled (0 to 5+ years), to select their meal plan type and to indicate their living arrangement. We created a meals per week variable that ranged from 0 to 24 meals per week (24 per week is 3.5 meals per day) and a dummy variable indicating whether the student lived in campus housing (campus housing = 1). Years of enrollment was included because as years increase, residential students receive more flexibility in which meal plan they can purchase, but all residential students must purchase a meal plan. With time, students are able to purchase plans that have less dining hall meals and more flex dollars.

We controlled for stress because it has been associated with overeating and consuming calorically dense meals.[25] To measure stress, we used an item from the National College Health Association.[26] We asked, "In the *past 7 days*, how would you rate the overall level of stress you have experienced?" (0 = no stress to 4 = tremendous stress). We modified the question to ask about the past 7 days instead of the past year. Studies have also shown differences in fast food consumption by race[27] and sex.[4] We asked students to identify their sex (Female = 1). Lastly, we asked students with which race or ethnicity they identified ("black or African American," "white or European American," "Latino (a)," "Asian," and "other"). We used white as the referent category in our regression models and grouped Latino, Asian and other into the other category based on low percentages in each.

Statistical analysis

We completed analyses with the statistical software program IBM SPSS Statistics version 20.[28] We provide descriptive statistics including means (SD) and medians for our main study variables, and bivariate correlations between our predictor and dependent variables.

The number of meals obtained from fast food restaurants was a count variable. The data were over dispersed (i.e., the mean did not equal the variance), making them a better fit for a negative binomial distribution rather than the Poisson distribution.[29] The dependent variable is log transformed during the regression analysis. We exponentiated or back logged the betas for easier interpretation (e.g. an exp (b) of 1.15 indicates a 15% increase in the number of meals obtained for every unit increase in the related factor.)

Results

The median total number of meals obtained from fast food restaurants was 3 (range = 0 to 32). Table 1a displays additional information on the meals obtained as well as descriptives for our main study variables.

Table 1a. Descriptive Statistics

	n	mean	SD	median
Total meals recorded in 7 day recall	973	19.71	8.21	19
Fast Food/Pizza meals obtained total	973	4.38	4.70	3
Fast Food/Pizza meals obtained on campus	973	2.90	3.96	1
Fast Food/Pizza meals obtained off campus	973	1.48	2.82	0
Days spent on campus	969	6.13	1.28	7
Flex Plan in $100s	948	3.83	2.84	4
Health Consciousness score	943	1.16	1.16	1

We present the bivariate correlations in Table 2a. Exposure, as days on campus, was positively associated with fast food meals obtained on campus ($r = .11$, $p < .001$) and negatively associated with those obtained off campus (r =-.23, $p < .001$). Given these opposite associations,

there was no bivariate relationship between days on campus and total fast food meals obtained. The amount of flex dollars on a meal plan was positively associated with fast food meals obtained in all situations and health consciousness was negatively associated with number of fast food meals.

Table 2a. Correlation Matrix

	Fast Food Pizza Total	Fast Food/Pizza On	Fast Food/Pizza Off	Days on Campus	Flex Plan in $100s
Fast Food/Pizza Total					
Fast Food/Pizza On	0.78**				
Fast Food/Pizza Off	0.52 **	-0.06			
Days on Campus	-0.05	0.11**	-0.23**		
Flex Plan in $100s	0.30**	0.25**	0.14**	-0.01	
Health Consciousness	-0.20**	-0.15**	-0.11**	-0.04	-0.72*

** Correlation is significant at the 0.01 level (2-tailed).
* Correlation is significant at the 0.05 level (2-tailed).

We tested whether days on campus, financial access, and health consciousness were associated with the number of meals that college students obtained from fast food restaurants with 3 negative binomial regression models. We controlled for race, sex, residential status, stress level, hours worked for pay, meal allowance, years of enrollment and total meals eaten in the past 7 days either on campus, off campus or both. We present the exponentiated betas, SEs and confidence intervals in Table 3a.

Days on Campus. We found no significant association between the number of days spent on campus and the outcome variables (i.e., total fast food meals (exp $(b)_{days}$ = .99, p =.63), on campus fast food meals (exp $(b)_{days}$ = 1.04, p =.38), off campus fast food meals (exp $(b)_{days}$ = .93, p =.13).

Financial Access. We found a positive association between the amount of flex dollars purchased on a meal plan and total meals obtained from fast food restaurants ($\exp(b)_{\text{flex\$\$}} = 1.05$, $p = .01$). Total meals from fast food restaurants increased by 5% for every $100 flex dollars. We also found a positive association between the amount of flex dollars on a meal plan and meals obtained from fast food restaurants on campus ($\exp(b)_{\text{flex\$\$}} = 1.05$, $p = .01$) and off campus ($\exp(b)_{\text{flex\$\$}} = 1.06$, $p = .05$).

Health Consciousness. We found a negative association between health consciousness and total meals obtained from fast food restaurants ($\exp(b)_{\text{health consciousness}} = .77$, $p < .001$). For every one-point increase in the level of health consciousness, meals obtained from fast food restaurants decreased by 23%. We also found a negative association between health consciousness and meals obtained from fast food restaurants on campus ($\exp(b)_{\text{health consciousness}} = .80$, $p < .001$) and off campus ($\exp(b)_{\text{health consciousness}} = .70$, $p < .001$).

Table 3a. Results of Negative Binomial Analysis on Fast Food and Pizza Consumption (N = 875)

	Model 1 Number of fast food meals obtained in total			Model 2 Number of fast food meals obtained on campus			Model 3 Number of fast food meals obtained off campus		
Variables	B	SE	exp(b) (95% CI)	B	SE	exp(b) (95% CI)	B	SE	exp(b) (95% CI)
Black	0.25**	0.08	1.29 (1.10,1.51)	0.29**	0.10	1.33 (1.09, 1.63)	0.18	0.13	1.19 (0.93, 1.53)
Other	-0.02	0.11	0.979 (0.80,1.20)	0.02	0.13	1.02 (0.79, 1.32)	-0.21	0.18	0.81 (0.57, 1.15)
Female	0.01	0.09	1.01 (0.84, 1.20)	0.05	0.12	1.05 (0.84, 1.31)	-0.15	0.15	0.86 (0.65, 1.15)
Campus Housing	0.08	0.13	1.09 (0.84, 1.14)	0.17	0.17	1.19 (0.86, 1.65)	0.07	0.22	1.07 (0.70, 1.65)
Level of Stress	0.04	0.04	1.04 (0.96, 1.13)	0.05	0.05	1.05 (0.84, 1.31)	0.06	0.06	1.07 (0.94, 1.21)
Hours Worked	0.01*	0.00	1.01 (1.00, 1.02)	0.01	0.01	1.01 (1.00, 1.02)	0.02*	0.01	1.02 (1.00, 1.03)
Meal Allowance	-0.08*	0.04	0.92 (0.86, 0.99)	-0.10*	0.04	0.90 (0.83, 0.99)	-0.05	0.06	0.96 (0.85, 1.07)
Years of Enrollment	-0.01	0.04	0.99 (0.92, 1.07)	-0.02	0.05	0.98 (0.88, 1.09)	0.01	0.06	1.01 (0.89, 1.14)
Total Meals[a]	0.04**	0.00	1.04 (1.03, 1.05)	0.07*	0.01	1.07 (1.06, 1.08)	0.13**	0.01	1.14 (1.12, 1.16)
Days on Campus	-0.02	0.03	0.99 (0.93, 1.05)	0.04	0.04	1.04 (0.96, 1.12)	-0.07	0.05	0.93 (0.85, 1.02)
Flex Plan in $100s	0.05*	0.02	1.05 (1.01, 1.09)	0.05*	0.02	1.05 (1.00, 1.11)	0.06*	0.03	1.06 (1.00, 1.13)
Health Consciousness	-0.26**	0.04	0.77 (0.71, .084)	-0.23**	0.05	0.80 (0.72, 0.89)	-0.36**	0.07	0.70 (0.61, 0.80)

Notes. [a] total meals on campus, off campus, and both as indicated. * p < .05, ** p < .01

Comment

We did not find support for our hypothesis that the number of days spent on campus (i.e., exposure to fast food restaurants) was associated with the number of meals obtained from fast food restaurants. In other words, spending more time on campus was associated with a higher number of meals, but the proportion of those meals from fast food restaurants did not increase. We did find evidence to support our hypotheses regarding financial access and health consciousness.

Students in our sample may have had a higher than average rate of fast food meal consumption than similar aged adults, putting them at risk for obesity. Students in our sample

obtained about 23% of their meals from fast food restaurants (mean total fast food meals/mean total meals), which implies that 23% of their calories are in the form of fast food. This is higher than the amount noted in a Center for Disease Control & Prevention study, which found that this age group receives 15% of their daily calories from fast food.[1] Half of the students in this sample reported obtaining 3 or more meals from fast food restaurants per week.. Jeffrey et al[30] found higher BMIs in persons who dined at fast food restaurants as little as once a week, and Pereira et al[31] found that young adults who dined at fast food restaurants three or more times a week gained about 10 pounds more over 15 years than those who ate at fast food restaurants less than once a week.

Health consciousness (defined here as monitoring calories, limiting fats and reading nutrition labels) may offer a protective effect against frequent fast food consumption. Our results only indicate that fast food meals and health consciousness are correlated. We do not know if one item, e.g., monitoring calories is more important than another e.g., reading nutrition labels, or if having a higher level of health consciousness causes someone to limit the number of meals from fast food restaurants. However, these results suggest that one avenue for intervention research could explore whether increasing health consciousness among college students reduces their fast food meal consumption. Health consciousness could also affect choices made at other restaurants. Emerging research suggests that meals obtained from quick service, fast food, pizza, fast casual, table service and independent restaurants all provide excess calories, sodium, sugar and fat.[13,32] In addition, menu labeling could be used to decrease the amount of calories consumed from restaurant foods. Research suggests that providing calorie information at the point of purchase leads some college students to make healthier (i.e., less calories, fat and sugar) choices.[6]

Limitations

Our work has some limitations. Regarding exposure, there are several reasons why the number of days spent on campus may not have led to an increase in number of 'on campus' fast food meals obtained in our sample. First, we assumed that the high density of fast food restaurants was unique to the campus environment and that being on campus more often would equal more exposure. It is possible, however, that this specific geographical area is itself dense with fast food restaurants and that time on campus does not actually increase exposure to this type of restaurant. In addition, the limited range in number of days spent on campus and the nearness of most off-campus students to campus may have created an almost constant exposure for those participating in this study. The average number of days students reported spending on campus the week of our survey was six (out of seven) and 92% of the respondents lived on or within 2 miles of campus indicating very little variance in our predictor of exposure. Our findings may reflect the recent observation of Hoy and Wansick,[33] that 75% of meals are obtained from within 3 miles of a person's home. Nearly all of the students who took part in the survey lived within 2 miles of the campus. In the future, researchers could assess the impact of exposure to fast food restaurants by comparing college campuses with varying numbers of fast food restaurants.

Even if exposure to fast food restaurants was not different on and off campus, financial access was (6 outlets vs. 2) and yet, we found that the amount of flex dollars purchased at the start of the semester was positively associated with the number of fast food meals obtained in total and on and off campus. We did not expect flex dollars to be associated with an increase in fast food meals off campus. There are several possible explanations for this association. One plausible explanation for the off campus relationship may be related to personal characteristics of students who purchase meal plans with high amounts of flex dollars. Though flex dollars can be used in the dining hall and mini-marts, it is possible that students who chose meal plans with

higher amounts of flex dollars did so because they like to eat fast food (or their friends do, and they like to eat with their friends). It is also possible that students who purchase a higher number of flex dollars believe that fast food restaurants offer more economic value and therefore they purchase a plan that provides them with greater access to these meals. It could be that these other factors are driving the association not the flex dollars themselves. We are not able to rule out these other factors in the current study, but future studies should collect information on individual level factors such as personal and social preferences around eating.

Another issue with the flex dollar allowance is that it may not be a reliable measure of financial access. The range of flex dollars, $100 to $1050, was the amount available at the start of the semester, but our study took place during the final four weeks when the level of the predictor was likely to be different. It is possible that a person who purchased a high flex allowance had less financial access (flex dollars) at the time of the study than a person who purchased a low flex allowance. In future studies, operationalizing financial access as the amount of flex dollars available at the time of the study would allow researchers to more reliably assess the association between financial access and fast food meals.

Some caution is suggested regarding generalizability and interpretation of results. First, our study occurred at one southeastern university and may not represent the behavior of students at other universities or students not on a meal plan. Second, we do not know if the 7 days that students recalled were typical, nor if the students consumed excess calories, sugar or saturated fats by eating at fast food restaurants (the link between consumption and weight gain). We asked students to provide only 7 days of information, which increases the reliability of their recall compared to a longer recall period. It is possible that some persons were having unusual weeks, but a 7 day time frame provided an adequate measure of group averages.[34] We asked students to tell us meal location, not content. We believe that this reduced error related to social desirability

bias, suggesting that, mistakes and survey design flaws withstanding, the food source information is reliable. Twenty three percent of student meals came from fast food restaurants, but we do not know if this is leading to excess overall or per meal calorie consumption. Additional research is needed to assess this important outcome. A next step could be to conduct an intercept study at on campus restaurants as has been done for chain restaurants in New York City.[35] In an intercept study, researchers could collect sales receipts in order to calculate the number of calories purchased per meal. We recommend that future research also include a more representative sample and compare meal plan versus non-meal plan students.

Conclusions and recommendations

Frequent consumption of fast food meals may lead to the overconsumption of calories, saturated fat, sugar and sodium, weight gain, and obesity.[5,10,11] College students may be at increased risk for these adverse outcomes due to exposure to multiple quick service and fast food restaurants both on and off campus and the ability to access them with their student meal plans.

In our sample, level of health consciousness based on 4 specific health behaviors was consistently associated with obtaining fewer meals from fast food restaurants and could be an important individual level factor. College administrators could promote and expand menu labeling for all campus eating venues (to increase awareness of caloric amounts), and student wellness staff could implement educational programs that raise health consciousness by focusing on the importance of consuming nutritious, calorie appropriate foods and using nutrition labels to do so.

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CHAPTER III

DOES PROVIDING NUTRITION INFORMATION AT VENDING MACHINES REDUCE CALORIES PER ITEM SOLD?

Abstract

In 2010, the US government passed a national restaurant menu labeling law that included vending machine companies. Research suggests that menu labeling in restaurants may reduce the number of calories purchased. We tested the effect of providing nutrition information and 'healthy' labels at the vending site in college residence halls. Our study took place at one southeastern university during October and November of 2012. We randomly assigned 18 vending machines to an intervention condition where we posted nutrition information, interpretive labels and sent residents a promotional email or to a control condition where we did nothing. We tracked sales 4 weeks before and 4 weeks after we introduced the intervention. Providing a multi-component intervention package did not change the purchasing behavior of this population. We make specific recommendations for additional research on nutrition labeling at the vending site, including a possible test of label formats.

Key words: calories, snack foods, vending machines, point of purchase, menu law

Introduction

An increase in the number of meals and snacks purchased away from home (e.g., restaurants, vending machines) that are often high in calories, saturated fat, and sugar, have been associated with the rise in obesity in the United States and elsewhere.[1] Traditional vending machine snacks (e.g., chips, candy, pastry) are associated with 20% of the excess calories

Americans consume,[2] and vending machines account for five percent of away from home food and beverage sales.[2] Federal menu labeling legislation included in the 2010 Patient Protection and Affordable Care Act requires restaurants and large vending companies to make nutrition information available at the point of purchase, prior to purchase.[3] The main goal of menu labeling policies such as this law is to limit or prevent diet related disease by reducing the amount of calories Americans consume while eating out.[1]

The current body of evidence on vending snack labeling is limited and contradictory.[4-6] Wilbur et al [5] found that sales of snacks with 140 calories or less increased when their proportion to higher calorie snacks in a vending machine increased, but low calorie labels themselves had no effect. By contrast, Hoerr and Louden[4] found that when they increased the proportion of snacks that met a certain nutrition criteria, overall vending sales declined. When they added special labels indicating the products nutrition content, total sales increased but not to the original baseline, and the increase in sales was for items they considered less nutritious. When Larson-Brown[7] added nutrition labels to snacks, the sales of snacks which had more protein, calcium, thiamine, vitamin C and iron (items believed to be lacking in the American diet at the time) increased but so did sales of snacks which had lower amounts of these micronutrients. It is possible that the different time spans (i.e., late 1970s to 1993) of these studies could explain some of the contradictory findings.

In two more recent studies, [6,8] French and colleagues found that labels by themselves had minimal or no impact on vending behavior while price had a substantial impact in promoting the purchases of low fat snacks. In addition, they found that a label *plus* promotion condition increased sales of low fat snacks by about 8 percent, whereas the label alone had no effect.

Though vending studies suggest that a change in availability or price will lead to lower fat or lower calorie snack choices, the federal legislation only requires labeling and supports

education and promotion. In addition, the legislation is intended to change the amount of calories purchased, and to date, vending research has not assessed the impact of nutritional labeling and promotion on the number of calories purchased.

There is a separate body of research on food labeling which can guide the choice of label type.[9-12] After reviewing this research, the Institute of Medicine (IOM) recommended that a standardized system assessing a food item's calories, saturated fat, added sugar and sodium content be used to develop simple, interpretive labels.[12] This type of label has been shown to aid consumers in making dietary choices that align with dietary guidance (i.e., a diet low in calories, saturated fat, sugar and sodium).[12]

Because nutrition information labeling at the vending site is mandated by law, but only partially supported by research, we investigated whether a multicomponent nutrition intervention (i.e., nutrition information, interpretive label, and promotional health communication) would lead consumers to choose lower calorie snacks that were also lower in salt, sugar, and saturated fat. We tested how this multicomponent intervention would impact the behavior of college students, as research suggests they are at risk for weight gain due to their snacking and access to vending machines.[13,14] One study[15] showed that 76% of college students reported snacking from vending machines at least once a day and many campuses provide traditional vending machines in their academic buildings and residence halls.

Therefore, we conducted an experimental field study with college students. Our study tested the effect of an intervention package that included nutritional information, item labeling, and promotion/education. We focused on two separate outcomes. One outcome was the average amount of calories sold per snack, and the other was the proportion of snacks that contained fewer calories and less saturated fat, sugar and sodium than traditional snacks (labeled here as *Better Choice*). We hypothesized that under the intervention condition there would be a decrease

in the average calories per snack item sold and an increase in the proportion of snacks labeled *Better Choice* sold.

Methods

Study Sample**.** We conducted our study using vending machine sales from 21 machines located in 22 residence halls housing 4,128 students at one mid to large size southeastern university in the United States. Each residence hall contained only one snack vending machine, but one connecting set of halls shared a vending machine. At the end of our study, we only had valid sales data from 18 machines. The majority of students living in the final 18 residence halls were female (67%) and the average age was 19. Fifty seven percent were freshmen, and 91% were residents of NC. All residence halls were coed. The university institutional review board reviewed and approved the study materials and procedures.

Intervention. Our intervention included the application of a poster board adjacent to the vending machine. The poster board listed the Nutrition Facts Panel for each product within that vending machine. We also highlighted five products within the machine that met predetermined per package nutrition criteria (i.e., less than 200 calories, 2 grams or less of saturated fat, 0 grams of trans fat, 7 grams or less of sugar and less than 300 milligrams of sodium per package). We used these criteria (similar to those recommended by the Institute of Medicine[12]) to define the snack as a *Better Choice* compared to other snacks within the machine. We placed a sticker with the letters BC inside the machine next to these snacks.

We placed the labels and the criteria on the posters and explained the *Better Choice* criteria in a promotional email sent by the first author to residents in the intervention condition. University and community nutritionists reviewed the label criteria and the email message for accuracy. We did not provide information or send the promotional email to residents in the

control condition. Entrance to the residence halls was by keyed access such that sales should primarily reflect behavior of the occupants.

Procedure. Prior to the collection of any sales data, the vendor stocked the machines and agreed to keep the items consistent and in the same slots throughout the 8-week study. For each machine, the vendor provided a sheet that listed each snack name and its location inside that machine. We assessed the nutrient content from the Nutrition Facts Panel for all items listed. Seventeen of the machines contained 35 snack items and one machine contained 40 snack items.

At the start of week 5, we placed the nutrition posters in frames adjacent to the intervention machines. We placed a note on the machine to direct the customers' attention to the poster. On the same day that we placed the poster and note, we sent the students in those residence halls an email communication regarding the *Better Choice* criteria. The communication also announced the availability of nutrition information at their vending site. We collected data from October 2 to November 27, 2012.

The vendor provided us with sales data on the number of each snack item sold per machine for the eight continuous weeks. During routine service visits, the vending representative electronically counted the number of each item sold using a handheld computerized device. If the electronic device failed, the representative conducted and entered a manual count of the items. A manual count occurred 3 times during this study, once in a control machine and once in two intervention machines.

During the eight-week experiment, we conducted one manipulation check of a randomly selected group of machines. We did this to confirm that the snack items continued to match the posters. Our manipulation check found that one snack item had changed and we revised that particular poster. Otherwise, the posters accurately reflected the machine content and nutrient disclosures throughout the first 6 weeks of the study. Changes in snack items occurred in all but

one machine during the last two weeks of data collection (a range of 3 to 12 snacks changed within a given machine). The director of Residence Life confirmed that the posters remained intact and in location during the intervention phase.

At the end of the data collection period, we emailed a link to participate in a supplemental survey to all students living in the original 22 residence halls. We used the survey to complete a second manipulation check (e.g. did those who should have received the email communication receive it? Did they see the information at the vending machine?)

Research Design. We used a 2 (time) x 2 (condition) experimental design to test the effect of our intervention. We collected data throughout a four-week baseline period (pre intervention) during which we provided no information and throughout a four-week post intervention period (post intervention) during which we posted information and labels at the intervention machines. We used simple random sampling to assign the vending machines to condition (intervention or control).

Analysis. From the sales data we calculated the average calories per snack sold and the proportion of *Better Choice* snacks sold. We chose summary measures (pre intervention average for each machine and post intervention average for each machine) for analysis as they are considered the best way to capture differences between groups when the interest is in the difference before and after an intervention.[16] Summary measures were also necessary because the vending machines were not all on a weekly collection schedule (see below). We analyzed the dependent variables separately with a Repeated Measures ANOVA; one within-subject factor (i.e., pre vs. post intervention) and one between-subject factor (intervention vs. control). Our data met the assumptions of normality. We used Ver. 20 IBM/SPSS software for our analysis.[17]

When we met with the vendor to retrieve the sales data for our eight-week study, we learned that the machines were not all on a weekly service schedule. We reviewed the available

sales data and first determined which machines had data for both the 4-week pre intervention period and the 4-week post intervention period. We excluded 3 machines that only had post intervention data, leaving us with our sample of 18. These 18 machines had at least one set of sales data in the pre intervention weeks, however, 7 had missing data for week 4, which meant that the next available data point, e.g., week 5, would include sales from a pre intervention week. In other words, if there were missing data for week 4, the end of the pre intervention period, but data for week 5, the week 5 sales for that machine would include products sold during both a pre intervention and a post intervention week. To prevent confounding in these particular cases, we used the next available data point in the post intervention period and all those that followed (e.g., week 6 to 8).

Results

There were 3,850 students living in the residence halls where the final 18 machines were located (9 intervention, 9 control). There were more males (34.8 % vs. 30.4%) and more freshmen (63.1% vs. 47.1%) living in the intervention halls, but the differences were not statistically significant. We included sex and class as covariates in our models, and we present the adjusted numbers.

The average calories (SD) per snack sold across the 9 intervention machines at the pre intervention time point was 252 (24) and at post intervention the average was 251 (21). The average calories (SD) per snack sold across the 9 control machines at the pre intervention time point was 217(55) and at post intervention the average was 225(56). Available snacks ranged in calories from 100 to 470 per package. The percent of *Better Choice* snacks sold across the intervention machines at pre intervention was 6.17% (2.72%) and at post intervention, it was 6.92% (1.14%). The percent of *Better Choice* snacks sold across the control machines at pre

intervention was 8.24% (3.56) and at post intervention, the percent was 6.60% (2.66). The changes from pre intervention to post intervention were not statistically significant.

We did not find a significant interaction between intervention period and condition for the average number of calories sold per snack ($F_{(1,14)} = 0.51$, $p = 0.49$, $\eta p^2 = 0.04$). We did not find a significant interaction between intervention period and condition for the percent of *Better Choice* snacks sold ($F_{(1,14)} = 1.64$, $p = .22$, $\eta p^2 = .11$). See Table 1b for tests of effects.

Table 1b. F Tests for Main Effects and Interactions

	$F_{(1,14)}$	p	ηp^2*
Average Calories per snack			
Time	0.211	0.65	0.02
Condition	1.93	0.19	0.12
Time x condition	0.505	0.49	0.04
Proportion of Better Choice			
Time	2.12	0.17	0.13
Condition	0.568	0.46	0.04
Time x condition	1.64	0.22	0.11

* Partial eta squared is a measure of effect size.

Forty five percent of the students responding to the survey lived in the intervention residence halls. Of these 670 students, only 16% recalled getting the email health communication ($n = 106$) and of these students, only 63% ($n = 67$) said that they had read the email. Therefore, only 10% of students in the intervention halls who responded to the survey had read the email. Fifty-six percent of students living in the intervention halls *(*$n = 364$) said that they viewed the on-site nutrition information but 60% ($n = 192$) of them said it did not influence their purchasing decision. (Note. The n for each question varied slightly due to missing responses.)

Discussion

We did not find support for our hypothesis that a multicomponent intervention including nutrition information, an interpretive label and a health communication/promotional message would lead to a reduction in average calories per snack item purchased and an increase in the purchase of snacks labeled as *Better Choice*.

Our intervention combined 3 strategies which have shown promise in previous research (i.e., information, label, promotion).[4-8] In addition, we tailored our promotional component and delivered it directly, which follows the suggestion of French et al to use promotion outside of the vending setting with media (e.g., thru email).[8] We also used an interpretive label as suggested by the Institute of Medicine[12] however; we were not allowed to place the label directly on the product package.

There are several possible explanations for our lack of statistically significant findings. One is that the implementation of our intervention was compromised. In other words, the three components we used could be effective strategies for changing behavior if delivered at full dose and with fidelity. The survey responses from students in the intervention halls suggest that the promotional message did not work as expected. Very few students recalled receiving the message and an even smaller percentage reported reading it. In future studies, it might be necessary to use recurring promotions delivered multi- modally (e.g., email, university web pages, on site posters, social media, text messages). We attached the BC (*Better Choice*) symbol to the machine, where it may have been overlooked. Ideally, this interpretive label would be on the snack pack itself, where it is more likely to be seen and taken into consideration. Lastly, it is possible that there was a cross over effect due to students in different conditions communicating with each other and visiting each other's residence halls. If students in the control halls were

exposed to the intervention, they might change their purchasing behavior making it less likely for us to detect a difference between the two groups.

Another explanation could be that personal characteristics of the residents influenced purchasing behavior. We randomly assigned machines to condition with the intent of creating two homogenous groups that would only differ on exposure to the intervention. We controlled for potential differences in class and sex, but the groups may have differed on a characteristic that we did not measure (e.g., there may have been more public health or nutrition majors in the control group).

A third possible explanation is that the change in vending snacks during the last two weeks of the post intervention period could also have influenced our results. Ideally, the machines would have been the same in every aspect for the entire 8 weeks except for the introduction of information at week 5. It is possible that the new snacks introduced at week 7 were more or less popular than the replaced snacks and influenced sales. However, we did a follow-up analysis that included only the average of weeks 5 and 6 as the post measure, and this did not produce different results.

Lastly, the three components used in this study may be sufficient to change behavior and a longer study with a larger sample might have allowed us to detect this effect. It is also possible that the intervention would work in a different population and setting, such as with employees at a worksite. Of the 5 previous studies[4-8] that attempted to change behavior at the vending site, only two[4,7] took place at universities and none assessed nutrition use at vending sites in residence halls.

That said, it is worth considering whether (1) there is a more effective way to display information than is currently proposed by law or, (2) if a non-information strategy would work better to change behavior for this population. These are valid questions, as most college aged

students are in the age group (18 to 29) recently found to be the least likely to use nutrition information as it is currently available. [18]

First, we offer a suggestion that could improve vending labeling initiatives across populations: Use a different format for providing the nutrition information. Traditional vending machine snacks come in packages similar to those in grocery stores. Comprehensive studies on packaged foods conducted in the US,[12] UK[19] and Australia[20] found that consumers respond better to simple, interpretive labels[21] and one of the most effective types is the Multiple Traffic Light (MTL) placed on the front of the package.[22] Each selected nutrient (e.g., sugar, salt) is highlighted in a circle that is red, green or amber. Applying Front of Pack systems (which include a total calories declaration) would allow the vending customer to scan all product nutrition information simultaneously, something our study was not able to accomplish. The Multiple Traffic Light label has a second attribute. It can trigger a health appraisal, as the color red is often associated with danger.[23] As we do not know of any studies that have examined the traffic light approach with college students and vending snacks, we believe it is a fruitful area for future research.

Second, it is possible that non-information strategies would work better for the vending setting. Studies, including university field studies, that manipulated the availability of lower calorie snacks and/or the price of more nutritious snacks led to an increase in the sale of targeted snacks.[5,6] In fact, in worksites, schools and recreation centers, these strategies are recommended and used more often than information disclosures (see e.g., CDC Health Vending Policy, the County of San Diego Parks and Recreation Healthy Vending Policy).

In conclusion, we conducted a study on the use of nutrition information at the vending site in residence halls on a southeastern university campus. We did not find that providing and promoting nutrition information led to a significant decrease in calories per snack purchased or a

significant increase in the purchase of snacks labeled as *Better Choice*. It is possible that replication using careful fidelity checks and revision of the label and promotion components would provide the results we expected. However, it is also possible that alternative labeling would be a more effective information approach or that the information approach in general is inferior to less popular, but more effective pricing and availability strategies. As the law currently requires the disclosure of nutrition information, we suggest that future research also assess Multiple Traffic Light labeling at the vending site.

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CHAPTER IV

EPILOGUE

Dissertation Summary and Suggested Next Steps

An increase in the number of fast food and other meals that are obtained through away from home sources has been associated with the increase in the prevalence of obesity in the US.[1,2] The goals of this dissertation research were (1) to identify factors that predict the number of meals that college students obtained from fast food restaurants and (2) to test whether a particular strategy (i.e., providing nutrition information near vending machines) could change purchasing behavior at the vending site among college students. By identifying factors that predict the number of meals obtained from fast food restaurants, it may be possible to create programs or policies that encourage students to consume less fast food, which could in turn reduce the number of meals that college students obtain from fast food restaurants. If college students benefit from a multi-component nutrition information intervention by changing the type of selections made at away from home food sources, including vending machines, both college administrators and the Food and Drug Administration could apply this knowledge to nutrition labeling rules.

Study 1 of this dissertation tested three factors that might predict the frequency with which college students obtain their meals from fast food restaurants. The first potential predictor was *exposure* to fast food restaurants on their college campus, operationalized here as the number of days that college students spent on campus in the past 7 days. Using this definition, there was no evidence of a relationship between exposure and the number of meals obtained from fast food restaurants. These findings are contrary to studies that show living near one or more fast food restaurants increases restaurant patronage, excess consumption of calories and fat, and weight

gain.[1] One possible explanation for the null findings here is that 70% of the students participating in study 1 were on campus six or seven days a week. Because there was very little range in the number of days on campus, detecting differences among students on the outcome based on this factor would be difficult. In the future, including non-meal plan students in the study would likely increase the variability of days on campus, especially as a substantial number of meal plan students (80% in this case) live in campus housing. Including non-meal plan students would also increase diversity, because students in campus housing are traditionally younger and more often freshmen and sophomores.

Expanding the range in the number of days on campus may not correct the problem however, if number of days on campus does not capture the construct of exposure as had been conceptualized. The argument for this study was that college students are exposed to numerous fast food restaurants on campus and are at risk for frequent fast food meal consumption. In order to test this, the better comparison is the number of restaurants a student is exposed to, not whether a student was exposed more or less often to the same number of restaurants. Another limit in the current study is the lack of control for fast food density in the home environment for off campus students. Future work could address both issues by including multiple campuses with different numbers of fast food restaurants and by controlling for home exposure with GIS mapping. GIS mapping tools could be used to determine off campus students' exposure to fast food restaurants near their homes.

The second potential predictor was *meal plan financial access* operationalized as the amount of flex dollars that a student had on their meal plan at the start of the study semester. In this study, students who purchased meal plans with a higher allowance of "flex" dollars obtained more of their meals from fast food restaurants than those with lower purchased flex dollar allowances. As the positive association between flex dollars and fast food meals occurred both

on and off campus, it is possible that other factors besides flex dollars were driving the association. One possibility is that personal characteristics or social preferences of the students led them to purchase a meal plan with a higher flex dollar allowance. For example, a person who believes that fast food restaurants offer economic value might choose a meal plan with a higher flex dollar allowance, as might a person who likes fast food meals and whose friends are frequent consumers of fast food. Therefore, it could be one of these other factors, and not flex dollar allowance, that are leading to an increase in meals obtained from fast food restaurants. We cannot rule the other factors in or out from this research and others have found that meal plan access to fast food restaurants does increase college students fast food meal consumption,[3] therefore, additional research on this predictor is warranted. New studies should collect information on individual level factors (e.g., social norms around eating, taste preferences) and control for them in the analysis. This would allow us to make inferences on the unique effect of flex dollar allowance.

In addition to controlling for other factors, it makes sense to change the way meal plan financial access is operationalized in order to increase reliability of this measure. In the current study, it is possible that the association between flex dollar allowance and number of meals obtained from fast food restaurants is stronger than estimated. This is because the amount of flex dollars that the students had available at the time of the study (the week before they completed the survey) was very likely to be different from the amount purchased at the start of the semester. The study took place at the end of the semester and all students were getting prompts to spend their extra flex dollars. Though a student may have been trying to spend extra flex dollars, it is also possible that a student was running low on funds, and trying to conserve them. In addition, students could have added flex dollars to their meal plans during the semester. Therefore, at the time of the study, the value of the predictor was not likely to be the same as it was at the start of

the semester when it was measured. A person who purchased a plan with a low flex allowance might have had more flex dollars available at the time of the study than someone who purchased a plan with a higher flex allowance. This means that for data analysis, the person would be considered low on the predictor and their behavior associated with this low value, when instead, they have a high value on the predictor. The reverse could also be true. This lack of reliability – what should be high is low and what should be low is high, makes it harder to find a relationship – thus underestimating the effect. In the future, the ability to assess this relationship would be improved if financial access was operationalized as the amount of flex dollars available to the student at the start of the 7 days of recall. Alternately, researchers might consider conducting a longitudinal study where the outcome and the predictor are measured at multiple time points in order to control for weekly variations in financial access and to explore and control for differences based on campus wide events, (e.g., exams, promotions) .

The third potential predictor of the number of fast food meals obtained was *level of health consciousness* as measured by the average of a student's response to 4 dietary related items (i.e., I monitor my calories, saturated fat and fat intake, and I read nutrition labels). In this study, health consciousness was negatively associated with the number of meals obtained from fast food restaurants both on and off campus. This is a promising finding, though interpreted with caution as cross sectional studies do not infer causation. We do not know if a person's level of health consciousness caused them to obtain fewer meals from fast food restaurants. These results also pertain to the health construct as a whole whereas there may be differential correlations for each of the components. In order to determine if one or all of the components causes a person to purchase less fast food, an experimental study is necessary. For example, participants could have their level of health consciousness and fast food consumption measured and then be randomly assigned to a condition where some receive an intervention to increase their level of health

consciousness and others do not. After which, measures of both health consciousness and fast food consumption for the entire sample could be assessed to see if those with higher levels of health consciousness at time two also consumed less fast food.

In summary, study 1 found that number of flex dollar allowance was positively associated with the number of meals obtained from fast food restaurants and higher levels of health consciousness was negatively associated with the number of meals obtained from fast food restaurants. This study did not find an association between exposure (as measured by days on campus) and number of meals obtained from fast food meals restaurants. There were several limitations that could be addressed in future work.

Study 2 of the dissertation tested the effect of a three-component nutrition labeling intervention delivered at the vending site. In previous studies, the number of low fat or low calorie snacks purchased increased when vending customers at colleges or worksites were provided with information about a snack's nutritional content along with a promotion highlighting the presence and relevance of the information.[4,5] In addition, a study that used interpretive labels to indicate if an item was low in fat led to changes in vending purchases at secondary schools and worksites.[6] Therefore, the current intervention included three components in an attempt to reduce the average number of calories per snack sold and increase the proportion of snacks labeled as *Better Choice* sold. These three components were (1) nutrition information, (2) interpretive label, and (3) promotional message.

Study 2 did not provide evidence that the intervention was effective, which may be related to the study design and implementation or it could indicate that the intervention components do not work for this particular population or setting. With regard to the design, there were several issues. The first concern is that our study took place on a single university campus. This limits generalizability, and introduces the risk of contamination effects. From this study, we

cannot extrapolate to other populations and are limited, at best, to making assertions to the UNCG residential population. In addition, we cannot be certain that students in the control residence halls remained unexposed to the intervention throughout the study. It is possible that students living in the control residence halls saw the vending machine labeling when visiting their peers. If this were the case, the control students might have changed their snacking behavior making it appear that the intervention was not having an effect on the treatment group when in fact it could have been affecting both groups.

A second design issue is the small sample size. Because there were only 18 machines or subjects, our ability to detect small effects was compromised. In one of the vending studies mentioned earlier,[5] the labeling itself only changed sales by 1%. Restaurant studies[7], on the other hand, have shown a 6 to 14% decrease in calories purchased after nutrition information was provided. Our current sample size would not allow us to detect small changes.

The last design issue involves randomization. Randomization is used to create groups that are similar before being introduced to an intervention and the larger the sample, the more likely the success of randomization. In this sample, there were more freshman and males in the treatment condition, which was accounted for in the analysis. But the two groups may have been different on factors that were not measured and therefore not controlled for in the analysis. For example, it is possible that public health or nutrition majors represented more students in the treatment or control halls. This would only be a problem if, for example, nutrition majors who were already making low calorie snack purchases were in the treatment condition. In that case, a treatment effect might not be detected because the treatment group was already engaging in the desired behavior. What could be more concerning for this study is that the treatment and control groups had different measures on the outcome variable at the start of the study, however, our

study design (i.e., the within groups component) controlled for this. The best way to address the randomization concern and to detect small effects is to increase the sample size.

Our failure to find evidence of an effect may also be related to implementation of the intervention, specifically in how the components were introduced. The first component, nutrition information (i.e., the Nutrition Facts Panel), was presented on a poster board. Past research has found that the Nutrition Facts Panel is more effective when persons have higher than average nutrition knowledge.[8,9] In addition, previous vending studies with positive outcomes placed more succinct nutrition information on the front of the product package or on the vending machine,[10] which the vending partner in this study was unwilling to do. Though we placed a note on the machines and sent an email to alert the students of the poster boards, 40% of students did not see the email and 44% did not see the poster boards. Research pertaining to packaged foods and restaurant meals suggests that the best presentation of information occurs in the same line of sight as the product and its price, or the product description (i.e., menus and menu boards).[11] In one way, the poster board was a proxy for information in the line of sight, but the names of the snacks were not on the poster, nor were there pictures of the snacks. In future studies, it will be important to test the effect of nutrition information by placing it in the line of sight of selection, preferably on the package itself.

The way the second and third components were introduced may also have had an impact on the results. Just as nutrition information works best when placed on the product so does the interpretive label. We were able to place an abbreviated *Better Choice* label inside the machine (i.e., **BC**) but not on the packages. The goal was to make identification of the snacks that met labeling criteria easier to locate. It is possible that the labels were over looked, or that their meaning was unknown. The third component, a promotional message that 1) explained the better snack criteria, 2) justified the need for better snacking and 3) promoted the use of

information, may not have reached the intended audience. The students in the treatment halls received this message through their email, at one time point only. As mentioned above, only 40% of the students in the treatment halls acknowledged reading the email.

Lastly, the components used in this study or nutritional disclosures in general, may not be effective with college students or in vending machines placed in college residence halls. Of the 5 previous studies that attempted to change behavior at the vending site, two of them took place in universities,[10,12] but neither occurred in residence halls where the primary customer was a student. In addition, the bulk of research demonstrating the effectiveness of interpretive labels has occurred in simulated experiments comparing food packages[6] or in restaurant labeling studies.[13] The current study appears to be the first to examine nutrition disclosure at vending machines in residence halls. A main rationale for menu labeling is that restaurant customers lack nutrition information on the meals sold there, cannot accurately estimate macronutrient content of them, and will choose lower calorie selections when given macronutrient information.[14] When designing this study, it was assumed that vending customers, specifically college student vending customers, also lacked nutrition information. If instead, college students already knew the information presented in this study, their behavior would not be expected to change. Another possibility is that the population in this study did not know the information, and would have responded to the intervention if the information had been presented in some other way. A recent Gallop poll found that the young adult age group was the least likely to view nutrition labels.[15] Therefore, it is possible that nutrition disclosure at the vending site could be effective in changing selections, if delivered in a way that college students preferred.

In addition to improving on the design, there are several other issues that could be addressed in future work. In order to determine if the components used in this intervention would work with other populations (e.g., employees, older adults) future work could test this

intervention in other settings (e.g., worksites) and among different age groups. In order to determine if the nutrition disclosures are necessary at vending sites in college residence halls, future work could assess the vending snack nutrition knowledge of college students, and if the findings suggested the need for nutrition disclosure, student preferences could be explored and disclosure types (e.g., interpretive labels, smart phone apps) tested for effectiveness.

In summary, study 2 was an experiment designed to test a three component intervention, but lack of fidelity (i.e., the components may not have been delivered exclusively to the residents in the treatment halls, and all the residents in the treatment halls did not receive each component of the intervention), the small sample, and the homogenous setting limit the ability to draw conclusions about the effect of this particular intervention. In order to address these issues, future research should include multiple settings and a greater number of machines in each condition. It would also be important for the nutrition information - preferably as an interpretive label - to be placed directly next to the snacks in the machine. Because it is possible that this particular intervention is not appropriate for the target population, but is effective for other groups, it should be tested in alternate settings as well. In addition, vending snack nutrition information and nutrition disclosure preferences of college students should be assessed.

Implications for the Field and Future Directions

The results of this dissertation work have research, practice and policy implications. Within its limits, study 1 found that financial access through a meal plan was associated with an increase in the number of fast food meals obtained, whereas increased levels of health consciousness was associated with fewer meals obtained. Number of days on campus had no association with the number of fast food meals obtained. Though our study does not confirm the work of others who found an association between exposure to fast food restaurants and patronage, this could be more a factor of how we operationalized exposure than a lack of association.

Therefore, it makes sense to consider reducing the geographical density of fast food restaurants as previous research has found this to be a protective strategy to reduce fast food meal consumption.[16]

The negative association between level of health consciousness and the number of meals obtained from fast food restaurants is correlational, but increasing students' awareness of dietary guidelines and the use of nutrition information to meet them might be a promising strategy that can be applied while additional research exploring causal effects continues. The items that made up the construct of health consciousness were, 1) monitoring calorie intake, 2) monitoring fat intake, 3) monitoring saturated fat intake, and 4) reading nutrition labels. Studies on menu labeling and use of the Nutrition Facts Panel support the link between understanding dietary guidance (i.e. the need to monitor fat and calories), reading nutrition information and making lower calorie selections.[14,17] Therefore, the adoption of nutrition-labeling policies for all eating venues on college campuses has the potential for reducing caloric excess. Providing information may seem contradictory, as some college students in our vending snack study said the available nutrition information did not influence their snacking decision, but we did not assess health consciousness in this group, nor do we know, as stated earlier, if the information was new to the students. It is just as likely that the students in the vending study had low levels of health consciousness and lacked general knowledge on dietary guidelines. By raising awareness about the need to monitor fat and calories and adding nutrition information labels at all points of food selection, college administrators could assist students in reducing excess caloric consumption. Simply placing calorie counts on a menu raises their level of importance,[17] and at the very least, providing nutrition information at the point of selection allows full disclosure for those who wish to make rational (e.g., weighing the benefits and costs of a choice) decisions about the foods they consume.

Although nutrition information at the point of selection, when coupled with high levels of health consciousness, may lead to a change in selections at away from home sources, the best way to provide that nutrition information, especially in college settings, remains unknown. Because complex nutrition information can result in processing overload, public health interventionists and policy makers need to find the most effective, simple approach to nutrition disclosure. Additional research in this area could involve a comparison of simple, but prominent interpretive labels and calorie only disclosures, which are currently suggested by law. This work did not address price or availability as alternative strategies to change selection behavior, but other studies[18] have and the US Government is moving to restrict access to high calorie vending snacks in public schools by introducing criteria, (e.g., less than 200 calories per snack) that disallows calorically dense, low nutrient content snacks to be sold in the machines. It seems important to test this strategy among college students as well.

This dissertation research intended to address the issue of caloric excess related to the frequency with which college students consume away from home foods. Two particular areas were studied and as a result, programming recommendations and next steps in research were suggested. As a body of work, this dissertation contains overall strengths and limitations. Specifically, the studies address two away from home venues, fast food restaurants and vending sites, which often provide consumers with excess calories, saturated fat and sugar.[19] A strength of this work is its field setting with a population that has a higher than average rate of fast food and vending food consumption.[20,21] Additional research specific to college students that builds on these results would move the field forward, especially if it addressed a main limitation of this work: one site, convenience sampling. Though challenging (e.g., coordinating implementation and data collection across sites), by conducting this research in multiple locations both external and internal validity could be improved. For example, the results might generalize to a more

diverse set of college students and conclusions attributed to certain experimental factors such as an intervention package or campus food environment could be partialed out from other campus specific attributes. The inclusion of non-college students as a comparison group, would allow researchers to pull out the unique dietary risks and programming benefits for college students, in regards to caloric excess related to away from home food consumption.

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APPENDIX A

CHAPTER II SUPPORTING DOCUMENTS

IRB Approval

THE UNIVERSITY of NORTH CAROLINA
GREENSBORO

OFFICE OF RESEARCH INTEGRITY
2718 Beverly Cooper Moore and Irene Mitchell Moore
Humanities and Research Administration Bldg.
PO Box 26170
Greensboro, NC 27402-6170
336.256.1482
Web site: integrity.uncg.edu
Federalwide Assurance (FWA) #216

To: Deirdre Dingman
Public Health Education

From: UNCG IRB

Date: 4/15/2013

RE: Notice of IRB Exemption
Exemption Category: 2.Survey, interview, public observation
Study #: 13-0126
Study Title: Correlates and frequency of Quick Service Restaurant patronage among college students

This submission has been reviewed by the above IRB and was determined to be exempt from further review according to the regulatory category cited above under 45 CFR 46.101(b).

Study Description:

Frequently consuming quick service restaurant (QSR) meals has been associated with poor diet quality and overweight. The purpose of this study is to 1) examine the relationship between QSR patronage and BMI in UNCG students, and 2) explore whether frequency of QSR patronage is associated with: meal plan type, amount of time spent on campus, or the student's level of health consciousness.

We will administer a survey through Qualtrics. All survey responses will be anonymous (i.e., no personal identifiers will be collected).

The results from this study could assist in creating strategies to promote healthy dining.

Study Specific Details:

- Your study is approved and is in compliance with federal regulations and UNCG IRB Policies. Please note that you will also need to remain in compliance with the university Access To and Data Retention Policy which can be found at http://policy.uncg.edu/research_data/.

Investigator's Responsibilities

Please be aware that any changes to your protocol must be reviewed by the IRB prior to being implemented. The IRB will maintain records for this study for three years from the date of the original determination of exempt status.

CC:
Kelly Rulison, Public Health Education

On line consent form

Hello! This survey is being used to collect information regarding meal choices by students currently enrolled in a university meal plan. Your participation is very important and appreciated. This survey should take 10 minutes or less to complete. You must be at least 18 years old to participate. Once you complete the survey, you will have the opportunity to be entered into a drawing to win one of 5 $100 Visa gift cards. The email address for the drawing will be collected in a separate survey and not linked to your survey responses. Absolute confidentiality of data provided through the Internet cannot be guaranteed. However, we are not collecting any personal identifying information as part of the survey and the risk of harm or discomfort is minimal. Your participation in this study is voluntary. You can omit answers to any question once you enter the survey. You can discontinue your participation in the survey at any time without penalty by simply closing the survey window. If you do not finish the survey in one sitting you will have one week to return and complete your survey. The survey will be closed 4/30/13. If you have any questions, please contact Deirdre Dingman at dadingma@uncg.edu Please choose one of the options below and click next to continue.

- ☐ I am under the age of 18.
- ☐ I would like to see more information about the study.
- ☐ I give my consent to participate.
- ☐ I do not wish to participate.

UNCG IRB
Approved Consent Form
Valid 4/15/13 to 4/14/16

Print copy of the online survey

1 Which statement best describes your current living situation?

- ❍ I live in UNCG campus housing (including UNCG apartments).
- ❍ I live in a Frat or Sorority House.
- ❍ I live off-campus, within walking distance to campus (i.e. less than 2 miles away).
- ❍ I live off-campus, more than 2 miles away from campus.

2 Still thinking of your current living situation, which statement best describes you?

- ❍ I live by myself.
- ❍ I live with one or more roommates (including in a Frat and Sorority House).
- ❍ I live with my parent(s).
- ❍ I live with my partner or spouse.
- ❍ Other _____

3 Where do you live?

- Bailey
- Coit
- Cone
- Weil/Winfield
- Cotten
- Gray
- Grogan
- Guilford
- Hinshaw
- Jamison
- Jefferson Suites
- Mary Foust
- Moore Strong
- North Spencer
- Ragsdale/Mendenhall
- Reynolds
- Shaw
- Spring Garden Apartments
- South Spencer
- Tower Village
- Spartan Village
- Philips/ Hawkins
- Lofts on Lee
- Other

4 What is the zip code where you currently live? (This information will help us understand the food options that you have available.)

5 During the past 7 days, how many days did you spend time on the UNCG campus?

- 0 days
- 1 day
- 2 days
- 3 days
- 4 days
- 5 days
- 6 days
- 7 days

6 Which one of the following meal plans were you enrolled in this semester? (Spring 2013)

- ❍ Spartan Unlimited (Spartan Restaurant and $100 dollars flex)
- ❍ Rawkin 19 (Spartan Restaurant 19 per week and $190 flex)
- ❍ Charlie's 10 (Spartan Restaurant 10 per week and $400 flex)
- ❍ Gold Pack 117 (Spartan Restaurant 117 per semester and $600 flex)
- ❍ Blue Pack 60 (Spartan Restaurant 60 per semester and $850 flex)
- ❍ Flex Pack 1050 ($1050 in flex only)
- ❍ Flex Pack 750 ($750 in flex only)
- ❍ Flex Pack 450 ($450 in flex only)
- ❍ Flex Pack 150 ($150 in flex only)
- ❍ Other _____

7 As of today, how many flex dollars do you have left on your meal plan? Please provide your best estimate if you are not certain.

The next set of questions is about the number of meals you have eaten in the last 7 days. Only count meals, not times when you just had a coffee or other beverage.

8 How many times in the last 7 days did you eat breakfast?

9 How many times in the last 7 days did you eat lunch?

10 How many times in the last 7 days did you eat dinner?

11 How many times in the last 7 days did you eat other meals (e.g., late night pizza run, late morning sandwich)?

In the next part of the survey, we ask you to tell us where each meal came from. This is the longest part of the survey. After you finish these questions, the rest of the survey should only take you 2-3 minutes.

12 Thinking off these ${q://QID84/ChoiceTextEntryValue} breakfast meals, where did each one come from? Please count each meal only once. You can leave any boxes that do not apply to your meals blank. You do not have to put 0s in these boxes. If you aren't sure how to classify the source of your meal, take your best guess.

	On UNCG campus	Off campus / delivery
Fast food place that serves mostly fried foods, burgers, or chicken (e.g., Wing Street, Coyote Jacks, Bojangles, Chick fil A, Church's Chicken, McDonald's)		
Pizza restaurant with delivery or counter service (e.g., Dominos, Papa John's)		
Sandwich or salad shop (Subway, Panera Bread, Au Bon Pain, Wild Greens, Jersey Mikes, Jimmy Johns, Ghassan's)		
Asian restaurant with counter service (e.g., Thai Garden (EUC))		
Mexican restaurant with counter service (e.g., Taco Bell, Salsaritas, Qdoba, Chipotle)		
Coffee Shop (e.g., Starbucks, Coffeeology, Tate Street Coffee)		
Table Service Restaurants (e.g. Applebees, Olive Garden, Fridays, LoneStar, Thai Garden(Tate St))		
The meal came from home (e.g., prepared by you or someone you know), The Cafe (Spartan Restaurant), or you packed it		
The meal was prepackaged (e.g., from Outtakes, Olo Sushi)		

13 Thinking of these ${q://QID85/ChoiceTextEntryValue} lunch meals, where did each one come from? Please count each meal only once. You can leave any boxes that do not apply to your meals blank . You do not have to put 0s in these boxes. If you aren't sure how to classify the source of your meal, take your best guess.

	On UNCG campus	Off campus / delivery
Fast food place that serves mostly fried foods, burgers, or chicken (e.g., Wing Street, Coyote Jacks, Bojangles, Chick fil A, Church's Chicken, McDonald's)		
Pizza restaurant with delivery or counter service (e.g., Dominos, Papa John's)		
Sandwich or salad shop (Subway, Panera Bread, Au Bon Pain, Wild Greens, Jersey Mikes, Jimmy Johns, Ghassan's)		
Asian restaurant with counter service (e.g., Thai Garden (EUC))		
Mexican restaurant with counter service (e.g., Taco Bell, Salsaritas, Qdoba, Chipotle)		
Coffee Shop (e.g., Starbucks, Coffeeology, Tate Street Coffee)		
Table Service Restaurants (e.g. Applebees, Olive Garden, Fridays, LoneStar, Thai Garden (Tate St))		
The meal came from home (e.g., prepared by you or someone you know), The Cafe (Spartan Restaurant), or you packed it		
The meal was prepackaged (e.g., from Outtakes, Olo Sushi)		

14 Thinking of these ${q://QID86/ChoiceTextEntryValue} dinner meals, where did each one come from? Please count each meal only once. You can leave any boxes that do not apply to your meals blank . You do not have to put 0s in these boxes. If you aren't sure how to classify the source of your meal, take your best guess.

	On UNCG campus	Off campus / delivery
Fast food place that serves mostly fried foods, burgers, or chicken (e.g., Wing Street, Coyote Jacks, Bojangles, Chick fil A, Church's Chicken, McDonald's)		
Pizza restaurant with delivery or counter service (e.g., Dominos, Papa John's)		
Sandwich or salad shop (Subway, Panera Bread, Au Bon Pain, Wild Greens, Jersey Mikes, Jimmy Johns, Ghassan's)		
Asian restaurant with counter service (e.g., Thai Garden (EUC))		
Mexican restaurant with counter service (e.g., Taco Bell, Salsaritas, Qdoba, Chipotle)		
Coffee Shop (e.g., Starbucks, Coffeeology, Tate Street Coffee)		
Table Service Restaurants (e.g. Applebees, Olive Garden, Fridays, LoneStar, Thai Garden(Tate St))		
The meal came from home (e.g., prepared by you or someone you know), The Cafe (Spartan Restaurant), or you packed it		
The meal was prepackaged (e.g., from Outtakes, Olo Sushi)		

15 Thinking of these ${q://QID87/ChoiceTextEntryValue} other meals, where did each one come from? Please count each meal only once. You can leave any boxes that do not apply to your meals blank . You do not have to put 0s in these boxes. If you aren't sure how to classify the source of your meal, take your best guess.

	On UNCG campus	Off campus / delivery
Fast food place that serves mostly fried foods, burgers, or chicken (e.g., Wing Street, Coyote Jacks, Bojangles, Chick fil A, Church's Chicken, McDonald's)		
Pizza restaurant with delivery or counter service (e.g., Dominos, Papa John's)		
Sandwich or salad shop (Subway, Panera Bread, Au Bon Pain, Wild Greens, Jersey Mikes, Jimmy Johns, Ghassan's)		
Asian restaurant with counter service (e.g., Thai Garden (EUC))		
Mexican restaurant with counter service (e.g., Taco Bell, Salsaritas, Qdoba, Chipotle)		
Coffee Shop (e.g., Starbucks, Coffeeology, Tate Street)		
Table Service Restaurants (e.g. Applebees, Olive Garden, Fridays, LoneStar, Thai Garden(Tate St))		
The meal came from home (e.g., prepared by you or someone you know), The Cafe (Spartan Restaurant), or you packed it		
The meal was prepackaged (e.g., from Outtakes, Olo Sushi)		

16 How well does each of the following statements describe you?

	Not at all like me	A little like me	A lot like me	Exactly like me
I try to monitor the number of calories I eat in a day.	❍	❍	❍	❍
I try to avoid high levels of FAT in my diet.	❍	❍	❍	❍
I try to avoid high levels of SATURATED FAT in my diet.	❍	❍	❍	❍
I spend time looking at nutritional labels while shopping for my food.	❍	❍	❍	❍

17 Which of the following best describes the use of your meal plan?

❍ I use my meal plan to purchase almost all (>90%) of my meals and snacks.
❍ I use my meal plan to purchase more than half (51-90%) of my meals and snacks.
❍ I use my meal plan to purchase about half (50%) of my meals and snacks.
❍ I use my meal plan to purchase less than half (11-49%) of my meals and snacks.
❍ I use my meal plan to purchase very few (

The following questions are included to help us see how groups may be similar and different in their preferences and use of the meal plans. Your answers will allow us to consider everyone's needs when updating programs and policies.

18 How many hours do you work each week (for pay)?

❍ None (I do not have paid employment)
❍ 10 or less hours per week
❍ 11 to 20 hours per week
❍ 21 to 32 hours per week
❍ More than 32 hours per week

19 How many years have you been a student at UNCG?

- ❍ 1 year or less
- ❍ 2 years
- ❍ 3 years
- ❍ 4 years
- ❍ 5+ years

20 During the Spring 2013 semester were you enrolled as a full time or part time student?

- ❍ Full time (12 or more semester hours)
- ❍ Part time (Less than 12 semester hours)

21 What is your current age?

22 What is your sex?

- ❍ Male
- ❍ Female

23 Which ethnicity/race do you consider yourself? You may check more than one.

- ❑ Black or African American
- ❑ White or European American
- ❑ Latino(a)
- ❑ Asian
- ❑ Other _____

We are asking the next two questions so that we can assess BMI.

24 How tall are you?

Feet
Inches

25 What is your current weight, in pounds?

26 Within the past 7 days, how would you rate the overall level of stress you have experienced?

- No Stress
- Less than average stress
- Average stress
- More than average stress
- Tremendous stress

27 In a usual week, how many times do you engage in moderate or vigorous physical activity for at least 20 minutes at a time (e.g., walking, swimming, cycling, aerobics, sports)?

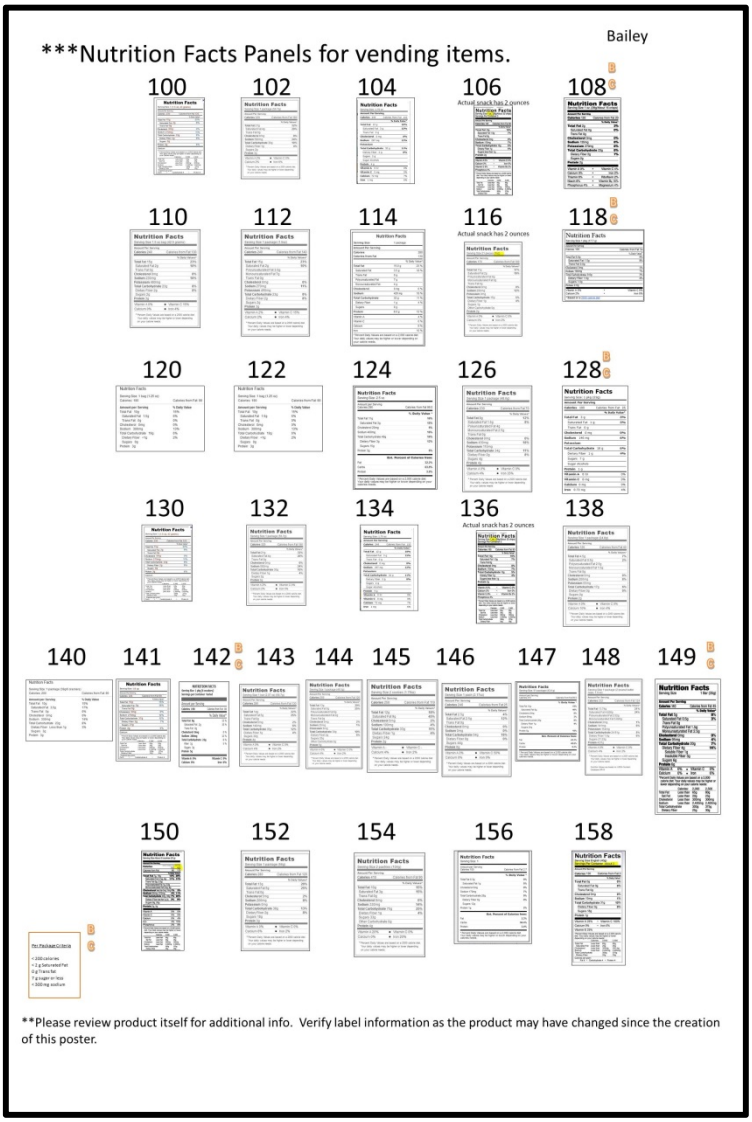
- Never
- Less than once a week (e.g., 2-3 times a month)
- Once a week
- 2-3 times a week
- 4-5 times a week
- 5+ times a week

To enter the drawing for a chance to win $100 please click here. If you do not wish to enter the drawing, simply click the next button to exit the survey.

APPENDIX B

CHAPTER III SUPPORTING DOCUMENTS

Poster with nutrition information.



Email communication.

This email is being sent to inform you of some changes in your dorm vending machines.

Six **Better Choice** items will be highlighted for you. Other available items may also meet the **Better Choices** criteria. Information on all products will be presented near the vending machines to help you make an informed decision.

WHY?

Meals purchased away from home, including vending machine snacks are often higher in saturated fat and sugar.

The **Dietary Guidelines for Americans** suggest that we limit saturated and trans fats, sodium and added sugars while increasing fruits, vegetables, fiber and healthy oils in our diets. Benefits from healthy eating include having more energy and being better able to handle stress.

We adapted criteria from the Institute of Medicine and Food Standard Agency to identify **Six Better Choices** within your vending machines.

Here are the criteria we used:

Per Package Criteria

< 200 calories
< 2 g Saturated Fat
0 g Trans fat
7 g sugar or less
< 300 mg sodium

Here is the information that you will see for all products and this is the symbol for a **Better Choices** snack:

In a few weeks, you will also have an opportunity to share your feedback, make suggestions and win prizes through a voluntary survey.

Learn more about the Dietary Guidelines here.