

A Comparison of Demographics and Purchasing Behaviors of Snack Vending Consumers  
at Different Locations in a Large University

Thesis

Presented in Partial Fulfillment of the Requirements for the Degree Master of Science in  
the Graduate School of The Ohio State University

By

Anne Michelle Klapheke, B.S.

Graduate Program in Human Ecology

The Ohio State University

2012

Thesis Committee:

Gail Kaye, PhD, RD, LD, PLCC - Advisor

Joshua Bomser, PhD

Elizabeth Klein, PhD

Copyright by  
Anne Michelle Klapheke  
2012

## Abstract

**INTRODUCTION:** To create a healthier eating environment, the Ohio State University decreased the proportion of unhealthy snacks in vending machines to 28.5 percent. Different groups (students, faculty, staff) access these machines; no data exists to compare these groups. The purpose of this research was to compare the demographic and purchasing behaviors of snack vending consumers at different locations across the Ohio State University campus. **METHODS:** The research design included a cross-sectional survey and focus groups. Survey participants included snack vending consumers (n=881) at 16 pre-selected vending machines from various campus locations. Trained data collectors observed vending patrons and conducted intercept surveys at each machine for 12 hours a day, on two consecutive days. Focus groups were conducted with student vending consumers (n=28) to gather in-depth data about factors that influence snack vending purchases. **RESULTS:** Survey results showed that vending consumers at the various locations differ significantly by age ( $p < .001$ ), university affiliation ( $p < .001$ ), frequency of purchases ( $p < .001$ ), and reasons for purchase ( $p < .001$ ). There were no differences in gender of consumers or type of snack item selected across locations; at least 60 percent of consumers at each location chose the least healthy options. Focus group data demonstrated that convenience and taste preferences strongly influence student vending purchases; point-of-purchase nutrition information could impact snack

selection. DISCUSSION: Despite differences in demographics and purchasing behaviors, campus vending consumers from different locations show similar preferences for less healthy snack items. Increasing the convenience of healthy options and providing nutrition information may promote healthier choices.

## Acknowledgements

I sincerely thank my advisor, Dr. Gail Kaye, for her enthusiastic support and skillful guidance in my research project. Her patience and positive energy were invaluable. I am indebted to the members of my research team: Michelle Caruso, Nicci Brown, Erica Baumker, Andrew Kruger, Elizabeth Freudenberg, and Alayna Markwordt. This research could not have been accomplished without their hard work and dedication. I sincerely thank my many data collectors for generously giving of their time and effort.

I thank my committee members Dr. Liz Klein and Dr. Josh Bomser for their support, guidance, and encouragement through my research process. I am grateful to Dr. Steve Naber for his expertise and assistance in the statistical analysis.

I thank my family, friends, and classmates for their unwavering support.

## Vita

May 2004 .....Bishop Fenwick High School  
May 2008 .....B.S. Biology, University of Dayton  
2010 to present.....Graduate Associate, Department of Human  
Nutrition, The Ohio State University

## Fields of Study

Major Field: Human Ecology

Specialization: Human Nutrition

## Table of Contents

Abstract .....	ii
Acknowledgements .....	iv
Vita .....	v
List of Tables .....	ix
List of Figures .....	x
Chapter 1: Introduction .....	1
1.1 Rates of obesity and snack consumption among U.S. adults.....	1
1.2 Snack vending at the Ohio State University .....	2
1.3 Research objectives and hypotheses .....	3
Chapter 2: Review of Literature .....	5
2.1 Introduction.....	5
2.2 Obesity and snack consumption in the adult population .....	5
2.3 Consumer demographics related to snacking behavior .....	6
2.3.1 Age.....	6
2.3.2 Gender .....	7
2.4 Factors that influence snack selection.....	8
2.4.1 Individual determinants .....	8

2.4.2 Environmental determinants .....	9
2.5 Results of nutrition interventions on snack selection .....	10
2.5.1 Altered availability.....	11
2.5.2 Point-of-purchase nutrition facts and education .....	12
2.5.3 Altered Price .....	13
2.6 Summary of literature review .....	16
Chapter 3: Methods.....	17
3.1 Cross-sectional survey .....	17
3.1.1 Survey methods.....	17
3.1.2 Survey data analysis.....	19
3.2 Focus groups .....	19
3.2.1 Focus group methods .....	19
3.2.2 Focus group data analysis .....	21
Chapter 4: Results .....	22
4.1 Survey results.....	22
4.2 Focus group results .....	28
4.2.1 Convenience.....	28
4.2.2 Taste preference .....	29
4.2.3 Price .....	30
4.2.4 Changing snack food purchases.....	31
4.2.5 Impact of nutrition information .....	31



Chapter 5: Discussion .....	33
5.1 Summary of results .....	33
5.2 Demographic differences of vending consumers.....	34
5.3 Factors that influence snack selection.....	35
5.3.1 Convenience and Taste .....	35
5.3.2 Potential impact of point-of-purchase nutrition information .....	35
5.3.3 Price .....	37
5.4 Implications.....	37
5.5 Limitations .....	38
5.6 Future research.....	39
5.6.1 Future research at the Ohio State University .....	39
5.6.2 Future research in the field of nutrition .....	40
References.....	41
Appendix A: Intercept Survey .....	45
Appendix B: Intercept Survey Consent Script.....	46
Appendix C: Email Collection Consent Script .....	47
Appendix D: Email Collection Form.....	48
Appendix E: Focus Group Recruitment Email .....	49
Appendix F: Focus Group Recruitment Flyer .....	50

## List of Tables

Table 1. Chi-square analyses for demographic variables by building type .....	26
Table 2. Chi-square analyses for purchasing behavior variables by building type .....	27
Table 3. Major themes of focus group discussions.....	28
Table 4. Descriptions of typical snack vending consumers at four campus locations.....	34

## List of Figures

Figure 1. Summary of survey sample size .....	23
---	----

## Chapter 1: Introduction

### 1.1 Rates of obesity and snack consumption among U.S. adults

The rate of obesity among U.S. adults has steadily increased over the last 50 years (1). Data from the National Health and Nutrition Examination Survey (NHANES) reported that 13.4% of U.S. adults, ages 20 and up, were obese ( $BMI \geq 30$ ) between the years 1960 and 1962 (2). The obesity rate increased to 23.3% by the early 1990's, and continued to rise to 33.8% by the year 2008 (1,2). The cause of this trend is unknown; it is likely that multiple factors are involved.

Increased energy intake from snack consumption among U.S. adults has been observed over the past 35 years. Piernas (2010) examined the snacking behavior of U.S. adults, ages 19 and older, from 1977 to 2006 and found an increase in the average number of daily snacking events, as well as an increase in the average number of calories per snack (3). From 1977 to 1978, the average number of snacks per day was 1.26 with each snack averaging 144 calories (3). Between 2003 and 2006, U.S. adults consumed an average of 2.23 snacks per day and 226 calories per snack (3). By calculation, from 1977 to 2006, the average energy intake from snack consumption in U.S. adults increased by an estimated 323 calories per day. There is insufficient evidence to show causation between snack consumption and increased rates of obesity. However, reducing the

number of daily snacking events and/or the number of calories per snack could reduce excessive energy intake.

## 1.2 Snack vending at the Ohio State University

Vending machines are a convenient, accessible snack source and are traditionally associated with energy-dense foods. In an effort to create a healthier campus food environment, the Ohio State University instituted a Healthy Snacking Program. The goal of the program is to promote healthier snack purchases by increasing the availability of nutrient-dense snacks and decreasing the availability of energy-dense, nutrient-poor snacks. As part of this program, the nutrition quality of all vended snack items on campus are evaluated by Snackwise®, a nutritional rating system developed by Nationwide Children's Hospital (4). Based on 11 nutrient parameters, snack items are rated and coded: green (purchase most often), yellow (purchase occasionally), or red (purchase rarely) (4). According to terms of the Healthy Snacking Program, snack vending machines on Ohio State's campus are required to stock 28.5% green items, 43% yellow items, and 28.5% red items.

In a study of Ohio State vending consumers, Caruso (2010) found that 59% of observed snack purchases (n=478) were red items (5). It is unknown how these findings compare with purchasing behaviors prior to the implementation of the Healthy Snacking Program. The study was conducted in classroom buildings and residence halls, and 86% of survey participants (n=356) were students (5). Snack vending machines are prevalent throughout Ohio State's campus in a variety of locations and are accessed by a variety of consumers. It is unknown how snack vending consumers at other locations compare to the population observed by Caruso in the classroom buildings and residence halls.

Knowing more information about the consumer population is important for developing future campus vending policies.

### 1.3 Research objectives and hypotheses

The purpose of this research was to compare the demographics and purchasing behaviors of snack vending consumers at a variety of campus locations at the Ohio State University. The research objectives were:

1. Determine if there is a difference in the demographics of campus vending consumers based on location of purchase. Demographic variables include gender, age, and university affiliation.
2. Determine if there is a difference in the purchasing behaviors of campus vending consumers based on location of purchase. Purchasing behavior variables include color of snack item purchased, frequency of purchases, and reason for purchase.
3. Determine the factors that most strongly influence snack selection among student vending consumers.

Quantitative techniques were used to investigate objectives one and two, while a qualitative approach was used to investigate object three. Corresponding research hypotheses for objectives one and two were:

1. Ho: There will be no significant difference in the demographics of campus vending consumers based on location of purchase.  
  
H1: There will be a significant difference in the demographics of campus vending consumers based on location of purchase.

2. Ho: There will be no significant difference in purchasing behaviors of campus vending consumers based on location of purchase.

H1: There will be a significant difference in purchasing behaviors of campus vending consumers based on location of purchase.

The corresponding research question for objective three was:

3. What factors most strongly influence snack food vending choices for college students at the Ohio State University?

## Chapter 2: Review of Literature

### 2.1 Introduction

Currently, there is no clear and consistent definition of what constitutes a snack food. This presents a challenge when trying to access and interpret research findings about snack foods and snack consumption (6). A snack food may be defined by nutrient content, time of consumption, the number of foods consumed at one sitting, eating frequency, and consumer self-report (6). Each method of defining a snack has its strengths and weaknesses, and no method is comprehensive. The ambiguity of what constitutes a snack food makes it difficult to study snack consumption, and to provide dietary recommendations for snack foods. Despite this challenge, recent trends in obesity and snacking behavior suggest that snack foods are making an important energy contribution to the American diet, and therefore warrant investigation (1,3,7). Research provides evidence regarding 1) consumer demographics related to snacking behavior, 2) individual and environmental factors that influence snack selection, and 3) the results of nutrition interventions on snack selection.

### 2.2 Obesity and snack consumption in the adult population

After a systematic review of literature, the 2010 Dietary Guidelines Advisory Committee concluded that there is limited and inconsistent evidence which suggests that increased body weight is associated with snack consumption (8). This conclusion was



based on a review of two prospective cohort studies. Halkjaer (2009) followed 42,696 Danish men and women, ages 50 to 64 years, for five years and found that waist circumference was positively associated with energy intake from snack foods (9). In this study, “snack foods” included items such as chocolates, sweets, candy, chips, and french fries (9). Woo (2008) followed 1,010 Chinese men over a five to nine year period and found that an increased variety of snack consumption was associated with an increased risk of becoming overweight (10).

## 2.3 Consumer demographics related to snacking behavior

### 2.3.1 Age

There is limited research on the effects of age on snacking behavior. According to studies by Nielsen (2002) and Glanz (1998), individuals across all age categories tend to choose the same snack items, although the reasons for snack selection may vary with age. Nielsen (2002) compared the eating behaviors of different age groups using data collected from three nationally representative surveys: the 1977-1978 Nationwide Food Consumption Survey (NFCS), the 1989-1991 Continuing Survey of Food Intake by Individuals (CSFI), and the 1994-1996 Continuing Survey of Food Intake by Individuals (CSFI) (11). Responses from the 63,380 participants were divided into four age categories: 2-18 years, 19-39 years, 40-59 years, and 60+ years (11). Survey data included information about energy intake from meals and snacks and the source of food, either at-home or away-from-home (11). The results showed an increase in energy intake from salty snacks, soft drinks, and pizza, as well as an increase in consumption of foods away-from-home (11). These trends were similar across all age groups (11). Using the results of two national cross-sectional surveys, Glanz (1998) found that reasons for food

selection varied with age: older persons were more concerned about nutrition and weight management, while younger persons were more concerned with cost and convenience (12). This study did not examine differences in the types of food or snacks consumed by age.

### 2.3.2 Gender

Despite the fact that females are more likely than males to be concerned about weight-control and the fat content of snacks, there is conflicting evidence as to whether there are gender differences in the types of snack foods consumed (13,14,15). In a survey of 65 college females and 64 college males, ages 18-40 years, differences by gender in snacking intentions and attitudes were found (13). As compared to men, women perceived sweet snacks to be more pleasurable and more detrimental to their health; and they were more likely to be pressured into not eating sweet snacks to avoid weight-gain (13). However, despite these differences in attitude, survey results showed no significant difference between males and females for the type of snack foods consumed (13). In a study by Huang (1994) 1,912 food and activity records of male (n=607) and female (n=1305) college students were analyzed (14). No significant difference was found in snacking frequency by gender (14). There was a significant difference in the types of snack foods selected by gender (14). Males were more likely to choose chips, candy bars, pizza, regular soda and beer; while females were more likely to consume crackers, popcorn, frozen yogurt and diet soda (14). Similarly, French (1999) reported that females were more likely than males to choose low-fat snacks from vending machines (15).

## 2.4 Factors that influence snack selection

### 2.4.1 Individual determinants

Evidence shows that taste is one of the most important factors in snack selection for all consumers (15-17). Other important factors include hunger, cravings, visual appeal of food, packaging, convenience, and price (15-17). The nutritional value of snack foods is seldom mentioned as an important factor in snack selection. Despite knowing the potential health risks associated with unhealthy snack foods, consumers will often opt for taste over health because they view snacking as a rewarding behavior, or they do not perceive themselves as being at-risk of diet-related diseases (16,17).

Focus groups held in southern England with adults and young adults (ages 20-60 years) examined perceptions of healthy snack alternatives and snack packaging (16). Results showed that most adults were knowledgeable about the potential negative impacts of consuming less-healthy snack options; however, they viewed snack foods as an opportunity to indulge in a “treat” or “reward” (16). The focus group discussions also revealed that packaging had a strong influence on snack purchases (16). Consumers’ choices could be swayed by bright and attractive colors, individually packaged servings, and marketing words such as “local”, “natural”, or “organic” (16).

Neumark-Sztainer (1999) conducted focus groups with adolescents (n=141) in the 7<sup>th</sup> and 10<sup>th</sup> grade to assess factors that influence teenage food choices (17). Although this population did not include college-age consumers, food preferences held during teenage years will likely persist into young adulthood. The results showed that the strongest influences on food choice (in order of importance) were hunger/food cravings, appeal of food (taste and appearance), time constraints, and convenience (17). Participants

expressed that the barriers to healthy eating were a low perceived susceptibility to diet-related health problems, the superior taste of “junk” food as compared to healthier food, and the low availability of healthier options (17). A noteworthy suggestion made by adolescent focus group participants was to make healthy foods the only option because high-sugar and high-fat foods will almost always be preferred if made available (17). Other suggestions included making healthful food look and taste better (17).

A study by French (1999) looked specifically at the motivations, beliefs, and behavior intentions of low-fat vending snack purchases (15). Survey data were collected from adolescents (n=419) and adults (n=226) as part of an intervention study in 12 schools and 10 worksites (15). In both adolescents and adults, taste was the most important factor in snack selection (15). Price was also very influential in both age groups (15). There was a higher frequency of low-fat snack purchases for consumers with positive beliefs about low-fat snacks and higher self-efficacy for selecting low-fat snacks; there was a lower frequency of low-fat snack purchases for consumers who were most concerned with taste and price (15).

#### 2.4.2 Environmental determinants

Little evidence exists to determine how the physical environment influences food choices in the university setting. Story (2002) suggests that schools can have a strong influence on student eating behavior by controlling the foods that are available (18). Typical food sources in the university setting include dining halls, vending machines, local eateries, and “at-home” food supplies (dorm room, apartment, sorority/fraternity house). Limited data suggest that location of residence may impact the variety of a

student's diet, and that students may stock up on unhealthy snack items in dorm rooms (19,20).

Brunt (2008) compared the dietary variety of students living on-campus, off-campus, or with parents (19). The results found that students living on-campus consumed a greater variety of fruits, vegetables, and dairy products compared to students living off campus (19). Students living off-campus were more likely to be overweight or obese compared to students living on-campus or with parents (19). Location of residence had no significant impact on the variety of snack foods consumed (19). Nelson (2009) took a food and beverage inventory of 100 student dorm rooms in a large public university (20). The five most common categories of items were salty snacks and other savory items, cereal or granola bars, main dishes, desserts or candy, and sugar-sweetened beverages (20). Survey results reported that high-calorie and high-fat items were more likely to be purchased by parents of the students, while the students themselves were more likely to have purchased main dishes, low-calorie beverages, fruit and vegetables, dairy products, and tea/coffee (20).

## 2.5 Results of nutrition interventions on snack selection

Interventions in the university setting have not been well-studied. Seymour (2004) reviewed all nutrition interventions with an environmental or policy component that appeared in peer-reviewed literature from 1970 to 2003 (21). Of the 38 interventions that were reviewed, only nine occurred in a university setting (21). Of these nine, six studies were conducted in cafeterias and three were conducted in vending machines (21). There are three typical methods of intervention: altering food availability, providing point-of-purchase nutrition facts or education, and altering price.

### 2.5.1 Altered availability

Increasing the availability of food will lead to an increase in consumption. In a small work place study, Painter (2002) investigated the effect of visibility and convenience on the consumption of chocolate candies among 16 office workers (22). When chocolates were visible and conveniently located, consumption increased (22). Additionally, convenience was shown to have a greater impact on over-consumption than visibility alone (22).

A study at Michigan State University found that sales of healthy vending items were increased by a change in snack availability, but were unaffected by the presence of nutrition information (23). Four vending machines located in four different academic, non-residential buildings on the campus of Michigan State were observed for three years. Prior to the study, snack items were analyzed for their level of nutrient density and each item was assigned an Index of Nutritional Quality (INQ) score (23). A high score indicated the healthiest items (23). Snack items were divided into three categories: low, moderate, and high INQs (23).

During the first year of the study, the machines were stocked with 50% low INQ snacks (least healthy), 38% moderate INQ, and 12% high INQ (most healthy) (23). During the second year of the study, the proportions were changed to 25% low INQ, 38% moderate INQ, and 38% high INQ (23). From year one to year two, sales of the low INQ items decreased by 23% and sales of high INQ snacks increased by 17% (23). Although the percentage of high INQ snacks did go up, the increase was not as great as the researchers had predicted (23). Additionally, total sales during year two at the experimental machines decreased to 85.7% of year one sales despite a campus-wide trend

of increased vending sales (23). During the third year of the study, INQ proportions remained the same as year two with the addition of nutrition information posted at the machine (23). Point-of-sale nutrition information had virtually no effect on the proportion of sales by nutrient-density (23).

#### 2.5.2 Point-of-purchase nutrition facts and education

Providing point-of-purchase nutrition facts and education may increase the selection of healthier items, but research results are inconsistent (23-25). The effectiveness of point-of-purchase information may be impacted by other factors, such as price (25).

In a study of Subway restaurants in New York City, where calorie information is posted on the menu, patrons who reported seeing the calorie facts purchased an average of 52 fewer calories and than those who did not see the calorie facts (24). Thirty-seven percent of consumers who saw the calorie information said that it had an effect on their purchase; this 37% of patrons purchased an average of 99 fewer calories than those consumers who saw the calorie information but ignored it (24). In contrast, the previously discussed study at Michigan State University found that point-of-sale nutrition information had no impact on the choice of healthier snack items from vending machines (23).

A study conducted in a Canadian university cafeteria used point-of-purchase messages to promote the sales of vegetable baskets, fruit baskets, pretzels, and yogurt (25). The intervention used messages that focused on the price, convenience, taste, and energizing qualities of the target foods (25). The messages were displayed as large, colorful poster at the cafeteria entrance and also on small placards in front of the food items (25). Promotional messages were displayed for one item at a time; each promotion

period was one week (25). During their respective intervention weeks, there was a significant increase in yogurt and pretzel sales but no significant difference in the sales of fruit or vegetable baskets (25). The investigators suggested that price may have impacted the effectiveness of the intervention; fruit and vegetable baskets were more expensive than yogurt and pretzels (25).

### 2.5.3 Altered Price

Price alternation is often combined with other intervention strategies, such as altered availability or menu labeling; therefore, interpreting altered price as the exclusive cause of intervention outcomes can be challenging (26,27). Despite this challenge, several studies (26-31) show that price alteration consistently increases the purchases of targeted foods.

Cinciripini (1984) observed the purchases of 5,542 undergraduate students in a university cafeteria (27). Three strategies to change purchasing behaviors were tested during three different intervention periods (27). The intervention methods included 1) displaying calorie information for all food items at the cafeteria entrance, 2) identifying healthy selections with a green triangle label, and 3) offering a \$1 rebate with the purchase of 10 healthy items (27). The rebate intervention resulted in the most consistent behavior change for all consumers; there was a significant increase in the purchases of fruit, vegetables, soup, chicken, fish, turkey, and salad; while the purchases of high-fat and dessert items were reduced (27). Providing calorie information resulted in a decrease in carbohydrate, red meat, and regular dairy consumption, but did not promote an increase in the purchases of healthier items (27).



There are mixed results as to whether purchasing behaviors due to price reductions can be sustained after the intervention has ended (26,28). In a five-week study conducted in a cafeteria at the Harvard School of Public Health, a 20% price reduction of healthy foods was paired with the distribution of educational materials (28). During the intervention period, a 6% increase in the purchase of healthy foods was observed (28). During the five weeks post-intervention when prices returned to normal, the purchases of healthy items continued to rise to 17% (28). In a university office building cafeteria, a 50% price reduction of fruit and salad was paired with an increased availability of these items (26). During the three week intervention period, fruit and salad purchases increased threefold as compared to baseline (26). However, fruit and salad purchases significantly decreased to just above baseline values when the intervention was removed (26).

Research by French (29-31) shows that price reduction promotes the selection of healthier options from vending machines in universities and work places. A three week university intervention increased the sales of low-fat (< 3 grams fat) vended snacks by implementing a 50% price reduction (29). During weeks one and three of the study, prices were normal to provide pre- and post-intervention baseline data (29). The prices of low-fat items were reduced by 50% during week two (29). During all three weeks, low-fat items were labeled as containing < 3 grams of fat. There was no special advertisement to draw attention to the price reduction during week two (29). The sales of low-fat items increased significantly from 25.7% at baseline to 45.8% during the intervention (29). Sales of low-fat items dropped to 22.8% during the post-intervention

period when prices returned to normal (29). The total number of snacks sold did not differ between the intervention and baseline periods (29).

The CHIPS study (Changing Individuals' Purchases of Snacks) showed that even small reductions in price can lead to a significant increase in the selection of low-fat snack items (30). The CHIPS study conducted a 12-month intervention at 55 vending machines in 12 secondary schools and 12 work places (30). The study tested four different pricing levels and three promotional levels for low-fat items (30). The various pricing levels were 1) no price change, 2) 10% reduction, 3) 25% reduction, and 4) 50% reduction (30). The promotional levels included 1) no promotion, 2) low-fat labels, and 3) low-fat labels plus a promotional sign (30). All levels of price reduction significantly increased the sales of low-fat items (30). The effect of promotion and labeling on the increase of low-fat sales was small but significant (30).

An 18-month work place intervention also resulted in increased sales of healthier food and beverages (including snacks, frozen food, cold food, and cold beverages) by lowering the price and increasing the availability of the targeted items (31). The intervention was conducted in 33 food and beverage vending machines in four bus garages; two garages received the experimental conditions and two garages served as controls (31). The experimental conditions were a 50% increase in availability and an average price reduction of 31% of healthier food and beverage items (31). The increased sales of healthier items in the experimental garages ranged from 10% to 42% as compared to the control garages (31).

## 2.6 Summary of literature review

Demographic variables, such as age and gender, may impact snacking behaviors. The type of snack foods selected appears to be similar across all age groups, despite differences in the reasons for snack selection by age (11,12). Females are more likely than males to be concerned about the fat content of their snacks (13-15). However, there is inconsistent evidence as to whether there are gender differences in the type of snack foods selected (13-15). Taste preference is one of the most influential individual determinants of snack food selection (15,17). Even if the consumer is knowledgeable about nutrition, less-healthy snack options may be selected as a 'treat' or because the consumer has a low perceived risk of diet-related diseases (16,17). There is little evidence for which environmental determinants are most influential in the university setting regarding students' selections of snack foods. Limited data suggest that location of residence may impact the variety of a student's diet, and that students may stock up on unhealthy snack items when residing in dorm rooms (19,20).

Nutrition interventions attempt to alter the environment in some way, such as controlling food availability (22,23), providing point-of-purchase nutrition facts or education (24,25), or reducing prices (26-31). All three methods can potentially increase the selection of healthier foods and beverages, with price reduction showing the most consistent results (22-31).

## Chapter 3: Methods

A mixed methods approach was used to conduct this study. A cross-sectional survey was conducted to obtain a broad description of a large number of diverse vending consumers. Focus group discussions provided in-depth information about student consumer purchasing behavior that could not be captured in the survey. Combining these methods created a more complete description of student campus vending consumers.

The methods for both phases of the research were determined exempt by the Ohio State University Institutional Review Board. The methods of the cross-sectional survey received exemption on February 18, 2011 under protocol number 2011E0081. The focus group methods received exemption on April 21, 2011 under protocol number 2011E0272.

### 3.1 Cross-sectional survey

#### 3.1.1 Survey methods

The design of the first phase of the research was a cross-sectional survey of vending consumers at 18 campus locations. The methodology was based on a similar study conducted in the spring of 2010 (5). A purposeful sample of 18 vending locations was drawn from the highest grossing vending machines in five building types: classroom buildings, residence halls, office buildings, medical center buildings, and the Recreational Physical Activity Center (RPAC). The selected machines included:

- Residence Halls: Patterson Hall, Park Hall, Baker West, Baker East

- Classroom: Baker Systems Engineering, University Hall, Schoenbaum Hall, Evans Lab
- Office: Meiling Hall, Hamilton Hall, Biomedical Research Tower, Enarson Hall
- Medical Center: James Cancer Hospital, Rhodes Hall, Ross Heart Hospital, Cramblett Hall
- RPAC: lower level, third floor

The research was conducted over a three week period during February and March of 2011. Each vending location was observed for 12 hours a day, 7a.m. to 7p.m., for two consecutive days. During the study period, trained interviewers collected observable data for every consumer that purchased an item from the vending machine. The observable data included time of purchase, gender of the consumer, and item purchased (Appendix A). After the purchase was made, the interviewer approached the consumer to gain consent to participate in the survey (Appendix B). Survey data included age of the consumer, university affiliation, reason for purchase, and frequency of vending purchases (Appendix A). Survey participants were asked to give their email address if they were willing to be contacted for future focus group participation (Appendix C). The email addresses were recorded on a separate paper and could not be linked to the participant's survey data (Appendix D). After completion of data collection, each observation was labeled with the appropriate item color category (red, yellow, or green) according to the item selected and the nutrient analysis criteria of Snackwise® (4).

All survey data were categorical variables, except the 'reason for purchase', which was recorded as the consumer's response to an open-ended question (see Appendix A).

Five raters reviewed the ‘reason for purchase’ responses and determined categories for the responses. Each rater independently categorized every consumer response into one of the ‘reason for purchase’ categories. The final categorization of the ‘reasons for purchase’ was based on consensus of the raters.

### 3.1.2 Survey data analysis

Fleiss’ Kappa statistic was used to determine the agreement of the raters who categorized the reasons for purchase.

Data were analyzed using SPSS version 19. Three chi-square tests of independence were performed to determine if there was a difference between survey responders and non-responders (presence of response bias) for each of the following observable variables: location of purchase (building type), gender, and item color purchased. A log-linear model was also used to evaluate the simultaneous interaction of these three variables. Six chi-square tests of independence were performed to determine the relationship between the location of purchase (building type) and each of the following variables: gender, age, university affiliation, item color, frequency of purchase, and reason for purchase.

## 3.2 Focus groups

### 3.2.1 Focus group methods

Four focus groups were conducted with student vending consumers. Participants were recruited by email from contacts gathered during phase 1 (Appendix E) and by flyers posted on vending machines located in classroom buildings and residence halls (Appendix F). Participants received a \$20 Target gift card as compensation for their time.

Focus groups were conducted over a two week period in May of 2011. Focus groups were facilitated by a trained leader. Each focus group was documented by audio recording and a note-taker. The following root questions were asked:

1. How frequently do you purchase food from a vending machine on campus?
2. What kinds of snack items do you usually purchase from a vending machine?
3. When you purchase snacks from a vending machine, how do you decide which item to buy?
4. Decisions about eating are influenced by many factors. Some of these factors are external to us, such as cost or convenience. Other factors are internal, such as taste preference or cravings. What external factors influence your purchase of snack foods from a vending machine?
5. What internal factors influence your purchase of snack foods from a vending machine?
6. Between the external and internal factors, which has the strongest influence on your typical vending machine purchase?
7. What makes a snack food satisfying to you?
8. What would cause you to change the snack foods you typically purchase from a vending machine?
9. If nutrition information was easily available at the vending machine, how might that impact your snack food purchase?

### 3.2.2 Focus group data analysis

Audio tapes were transcribed and evaluated by methods described by Patton (32). Four reviewers analyzed the transcripts; one reviewer per transcript. Reviewers independently coded the content for major themes, by question. Consensus meetings with all four reviewers followed to compare and validate re-occurring themes between focus groups, by question.



## Chapter 4: Results

### 4.1 Survey results

A total of 970 vending consumers were observed. Observations from the RPAC (n=61) were excluded from the analysis because items offered in the RPAC vending machines differed from the other building types; a higher proportion of green and yellow snack items were available at the RPAC, therefore these machines were not comparable to the machines in the other building locations. Also excluded from the analysis were observations with an unknown item color (n=27) such as gum, mints, or incomplete recordings from the data collector. Finally, an erroneous observation made in Independence Hall (n=1) was removed. The final sample size used for analysis was 881 observed purchases and 587 consumers who chose to participate in the intercept survey (67% response rate). Figure 1 summarizes the sample size.

The analysis of the 'reasons for purchase' resulted in seven categories: convenience, health, hunger, meal replacement, snack, taste, and non-coded. The non-coded category included outlier responses such as purchasing for a friend or breaking a large bill for change. The results of Fleiss' Kappa showed substantial agreement between raters for the 'reason for purchase' categories ( $\kappa = 0.74$ ).

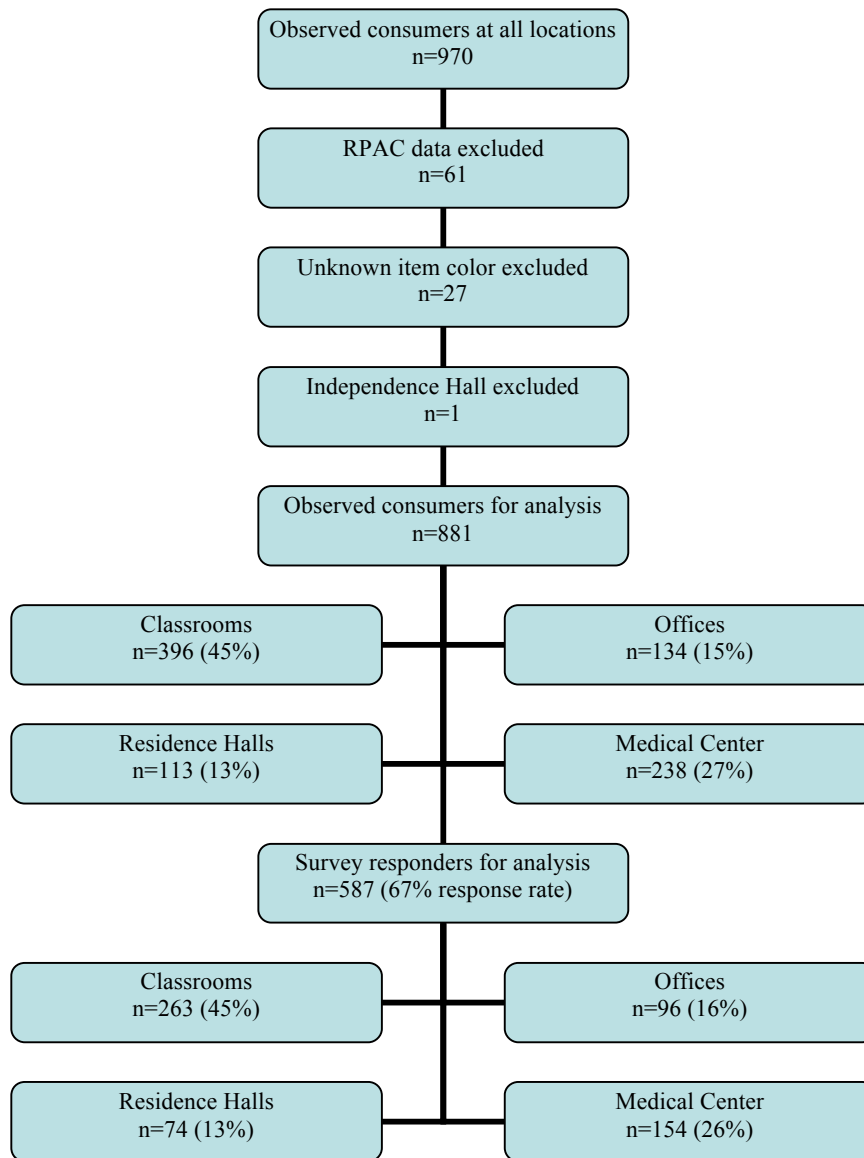


Figure 1. Summary of survey sample size

The results of the chi-square analyses to determine responder bias showed no significant difference in gender or location of purchase for responders versus non-responders. There was a significant difference between responders and non-responders

for item color purchased ( $\chi^2_1 = 12.823$ ,  $p=.002$ ). Non-responders were more likely to purchase red items than responders. The results of the log-linear analysis showed a significant interaction between gender and item color ( $\chi^2_1 = 14.688$ ,  $p=.001$ ). Male consumers who purchased red items were less likely to participate in the intercept survey than female consumers or male purchasers of green or yellow items. To reduce the impact of the possible response bias for item color and gender, the analyses that examine those two variables include all 881 observed consumers (responders and non-responders). For the variables of age, university affiliation, reason for purchase, and frequency of purchase, data were only available for the 587 responders, so the analyses of those four variables were restricted to survey responders.

The first research objective was to determine if there was a difference in the three demographic variables (gender, age, and university affiliation) of vending consumers based on location of purchase. Table 1 summarizes the results of the chi-square analyses for demographic variables. There was no significant difference in the gender of consumers based on the location of purchase ( $\chi^2_1 = 5.792$ ,  $p=0.122$ ). There was a significant difference in the age ( $\chi^2_{15} = 316.236$ ,  $p < .001$ ) and university affiliation ( $\chi^2_9 = 397.888$ ,  $p < .001$ ) of consumers based on location of purchase. There were higher proportions of consumers in the 18-24 year age range within the residence halls and classroom buildings as compared to the other building types. Conversely, the medical center and office buildings had higher proportions of older consumers. The residence halls and classroom buildings also had a higher proportion of students as compared to the other building types. Staff consumers were more prevalent in the medical center and

office buildings. The medical center also had a higher proportion of consumers who reported an affiliation of ‘other’.

The second research objective was to determine if there was a difference in the three purchasing behavior variables (item color, frequency of purchase, and reason for purchase) of consumers based on location of purchase. Table 2 summarizes the results of the chi-square analyses for purchasing behavior variables. There was no significant difference in item color based on the location of purchase ( $\chi^2_6 = 6.871$ ,  $p = .333$ ). There was a significant difference in the frequency of purchase ( $\chi^2_{15} = 40.526$ ,  $p < .001$ ) and the reason for purchase ( $\chi^2_{18} = 87.809$ ,  $p < .001$ ) based on the location of purchase. The residence halls had the highest proportion of the most frequent vending consumers. Sixty-nine percent of residence hall consumers reported making vending purchases at least once per week. The residence halls also had a higher proportion of consumers reporting “convenience” as the reason for purchase (66.2%). The medical center had a higher proportion of consumers reporting “snack” as the reason for purchase (24.7%). The proportion of consumers reporting “hunger” as the reason for purchase was higher in the classroom (27.4%) and office buildings (28.1%). Consumers in the classroom buildings also had a slightly higher proportion of “meal replacement” as the reason for purchase (11%).

Table 1. Chi-square analyses for demographic variables by building type

Demographic variable (n)	Classroom (n=396) <sup>1</sup> (n=263) <sup>2</sup>	Residence Hall (n=113) <sup>1</sup> (n=74) <sup>2</sup>	Office (n=134) <sup>1</sup> (n=96) <sup>2</sup>	Medical Center (n=238) <sup>1</sup> (n=154) <sup>2</sup>	P value <sup>3</sup>
n (% within building type)					
Gender (881)					.122
Female	212 (53.5)	73 (64.6)	80 (59.7)	143 (60.1)	
Male	184 (46.5)	40 (35.4)	54 (40.3)	95 (39.9)	
Age (587)					< .001*
18-24	206 (78.3)	72 (97.2)	27 (28.1)	12 (7.7)	
25-35	25 (9.5)	1 (1.4)	29 (30.2)	34 (22.1)	
35-45	12 (4.6)	0 (0)	14 (14.6)	34 (22.1)	
45-55	10 (3.8)	1 (1.4)	9 (9.4)	36 (23.4)	
55+	9 (3.4)	0 (0)	10 (10.4)	36 (23.4)	
Unknown	1 (0.4)	0 (0)	7 (7.3)	2 (1.3)	
University Affiliation (587)					< .001*
Student	229 (87.1)	72 (97.2)	35 (36.5)	7 (4.5)	
Staff	24 (9.1)	1 (1.4)	44 (45.8)	69 (44.8)	
Faculty	7 (2.7)	1 (1.4)	11 (11.5)	10 (6.5)	
Other	3 (1.1)	0 (0)	6 (6.2)	68 (44.2)	
<sup>1</sup> Sample size used for analysis of gender; includes all observed consumers					
<sup>2</sup> Sample size used for analysis of age and university affiliation; includes only survey responders					
<sup>3</sup> Chi-square analyses between building types					
* statistically significant					

Table 2. Chi-square analyses for purchasing behavior variables by building type

Purchasing behavior variable (n)	Classroom (n=396) <sup>1</sup> (n=263) <sup>2</sup>	Residence Hall (n=113) <sup>1</sup> (n=74) <sup>2</sup>	Office (n=134) <sup>1</sup> (n=96) <sup>2</sup>	Medical Center (n=238) <sup>1</sup> (n=154) <sup>2</sup>	P value <sup>3</sup>
n (% within building type)					
Item Color (881)					.333
Red	249 (62.9)	68 (60.2)	81 (60.5)	160 (67.2)	
Yellow	83 (21)	26 (23)	37 (27.6)	52 (21.9)	
Green	64 (16.1)	19 (16.8)	16 (11.9)	26 (10.9)	
Frequency of purchase (587)					< .001*
> 3/wk	37 (14.1)	14 (18.9)	13 (13.5)	31 (20.1)	
1-3/wk	103 (39.2)	37 (50)	29 (30.2)	46 (29.9)	
2/mo	29 (11)	10 (13.5)	16 (16.7)	15 (9.7)	
1/mo	32 (12.1)	1 (1.4)	21 (21.9)	14 (9.1)	
< 1/mo	62 (23.6)	12 (16.2)	17 (17.7)	46 (29.9)	
Unknown	0 (0)	0 (0)	0 (0)	2 (1.3)	
Reason for purchase (587)					< .001*
Convenience	92 (35)	49 (66.2)	28 (29.2)	67 (43.5)	
Health	14 (5.3)	1 (1.3)	5 (5.2)	3 (1.9)	
Hunger	72 (27.4)	5 (6.8)	27 (28.1)	23 (14.9)	
Meal Replacement	29 (11)	4 (5.4)	4 (4.2)	4 (2.6)	
Snack	28 (10.6)	5 (6.8)	11 (11.5)	38 (24.7)	
Taste	22 (8.4)	10 (13.5)	13 (13.5)	18 (11.7)	
Non-coded	6 (2.3)	0 (0)	8 (8.3)	1 (0.7)	
<sup>1</sup> Sample size used for analysis of item color; includes all observed consumers					
<sup>2</sup> Sample size used for analysis of frequency of purchase and reason for purchase; includes only survey responders					
<sup>3</sup> Chi-square analyses between building types					
* statistically significant					

## 4.2 Focus group results

A total of 28 individuals participated in one of four focus groups. All participants were students at Ohio State University. Of the 28 participants, 32 percent were male, and 68 percent were female. No other demographic information about the participants was collected. Table 1 summarizes major themes that emerged from the focus group discussions.

Table 3. Major themes of focus group discussions

<ol style="list-style-type: none"><li>1. Decisions to go to a vending machine are most strongly influenced by a convenient location of the machine and a convenient form of payment (BuckID).</li><li>2. Decisions about which item to purchase are often made before coming to the machine. Major factors that influence this decision include cravings and personal taste preferences. Price also has a minor influence.</li><li>3. Major factors that would cause vending consumers to change their snack food purchase include healthier options, unique items, and lower prices.</li><li>4. Available nutrition information at the vending machine would facilitate the choice of healthier items.</li></ol>
---

### 4.2.1 Convenience

Most participants reported that they use vending machines because of the convenience. Several participants stated that eating from a vending machine is usually not the preferred option, but rather the most readily accessible. This was supported by statements such as:

*I never look for vending machines. I just happen to come across it, and when I have some spare change or extra time.*

*I feel like the word convenience, like if I have change on me and a machine's down the hall, then I'll get it.*

*Convenience probably...because if I don't have time to go back to my dorm or go get a real meal then it's just convenient to go get a small snack to hold me over.*

*I usually only go to [vending machines] that are on my route to the next class.*

A convenient form of payment was also identified as a major factor that influences the decision to purchase from a vending machine. Many participants stated that they rarely carry cash or change, so they will only make a purchase if the machine offers BuckID as a form of payment. The following quotes exemplify this theme:

*Well, convenience for me because a lot of the vending machines on campus take BuckID and I usually keep like \$5-\$10 on my BuckID just in case I get hungry, but then like when I go to the business school, none of the machines take BuckID, so, I just never buy things from vending machines there because I don't carry cash on me.*

*If there's no...swipe access or whatever I don't use it at all.*

*Yeah, I'm a lot more likely to use a vending machine if I have my BuckID handy because I don't like searching for change, and it feels like you're giving more money just because you have to pay with the actual, you know, dollar rather than the card.*

#### 4.2.2 Taste preference

While convenience seems to be the strongest factor for going to a vending machine, personal taste preferences and cravings appear to have the biggest influence on which snack item to buy. Many participants indicated that they already know which item they will purchase when they approach the machine. This predetermined selection is often out of habit or based on a particular craving. The following quotes support this theme:

*Usually I know what I want when I go to the vending machines, so it's whatever I had in mind, that's what I end up buying.*



*I feel like I have, like an idea in my head about what I want ... I don't, like usually go up there to kind of see what I want. If I have a craving for chocolate, I'll just get chocolate.*

*I feel like I already know what I want before I even get there, usually. If it's one I go to frequently, I know what's in there.*

*I usually just get whatever I crave.*

#### 4.2.3 Price

Price also appears to have an impact on vending purchases. Some participants stated that they are deterred from purchasing anything from a vending machine because they believe they can buy the item for less at a store. On the other hand, some view vending machines as a cheaper alternative to fast food. Others are influenced by price while at the vending machine; if they are debating between multiple items, they will choose the cheaper option. The following quotes show consumers' views about vending machine prices:

*I would say sometimes I base it off of how much you can get it at the store. Like if it's closer to that price, because I know you can probably get like 3 or 4 at the price you buy at the store.*

*Comparatively, if I'm on, like closer to north campus I'm close to Subway and can walk there in like a minute, but I don't wanna spend five dollars on something. I'd rather spend a dollar and get something maybe not as desirable but cheaper, and if I only have a dollar I can still grab that.*

*I think the cost, also. If I want something really bad, and I see it's like 80 cents, I might get it, but if I see something similar for a little less, I might change my mind.*

*I would say, like the price of the items definitely influences because when I look at a pack of gum for like \$1.75 I'm like 'forget that'. You know rather than...you can get chips for like 75 cents, and that makes more sense to me.*

#### 4.2.4 Changing snack food purchases

When asked what would cause a change in their typical snack vending purchase, many participants mentioned that readily available nutrition information or healthier options would alter their choice. These responses were given before prompted with the final root question which specifically asked about the impact of nutrition information. Additionally, participants said they would change their purchase in order to try a new, unique item; or they would choose a reduced price option. The following quotes support these themes:

*If they had nutrition information of everything on there...like when other restaurants have that...when it's like in your face that what you're getting is 500 calories, I don't care how good this tastes, I can't eat that...so, I mean, if they had the nutrition information right there, I think that would influence what I pick.*

*If they had something healthy in there.*

*I feel like they pretty much have the same stuff in there, no matter where you go, so if they like, throw in something new, that I've either had before, or something I might like.*

*I think its variety for me, well in most vending machines there's generically the same big brand names, but if I saw something I normally don't see, like an offbeat thing...I would try that...*

*I would say price would influence me a lot too...so, if there was like a big difference...[and] I didn't absolutely hate the product, I'd probably buy the cheaper one.*

#### 4.2.5 Impact of nutrition information

When asked about the impact of nutrition information, most participants reported that nutrition facts at the vending machine would influence their purchase. Participants stated that nutrition information would promote the purchase of healthier snacks and/or deter the purchase of unhealthy items. However, some participants felt that vending machines

offer no healthy options, and that nutrition information would merely “help [them] choose the lesser of two evils”. The following quotes summarize participants’ views about the impact of nutrition information at the vending machine:

*I think it would...influence me a lot because...I would compare...the calories...and fat content. If it’s like, right next to the vending machine.*

*...if I wanted to get something healthy, then I would know what it was.*

*I would probably definitely choose things that were a lot less in calories...*

*It would definitely impact, I mean, when it’s right there in front of you, I think it’s harder, for me at least. I can lie to myself and be like ‘well this probably isn’t that bad for me’. But then when you’re actually looking at the nutrition information, sometimes it can change.*

*...it would make me feel more guilty buying a candy bar knowing nutrition info is right there.*

A minority of participants expressed that nutrition information at the vending machine would have no impact on their purchase. This is exemplified by the following quotes:

*I think for me, it wouldn’t matter because if I want something then I will get it.*

*I don’t think it matters for me because I don’t usually look at the nutrition label that much.*

## Chapter 5: Discussion

### 5.1 Summary of results

The purpose of this research was to compare the demographic and purchasing behaviors of snack vending consumers at different locations across the Ohio State University campus. Previous research had described vending consumers in classroom buildings and residence halls, but it was unknown how consumers at other campus locations compared. The four locations used for comparison were classroom buildings, residence halls, office buildings, and the medical center. By location, vending consumers were significantly different in age, university affiliation, frequency of purchases, and reasons for purchase. There was no significant difference in the gender of consumers or in the color category of the snack item purchased, by location.

Based on these results, characteristics of a typical vending consumer from each campus location are summarized in Table 4. Consumers were different in terms of university affiliation, age, frequency of vending purchases, and reasons for vending purchases at each location. However, consumers at each location showed no difference in the type (item color) of snack food purchased. At each location, at least 60% of consumers chose red items, the least healthy options.

Table 4. Descriptions of typical snack vending consumers at four campus locations

Residence Halls	<ul style="list-style-type: none"> <li>• Student</li> <li>• Age 18-24 years</li> <li>• Makes vending purchases at least once per week</li> <li>• Purchases from vending machines because it is convenient</li> </ul>
Classrooms	<ul style="list-style-type: none"> <li>• Student</li> <li>• Age 18-24 years</li> <li>• Purchases from vending machines because of hunger and to replace a meal</li> </ul>
Offices	<ul style="list-style-type: none"> <li>• Staff</li> <li>• Age &gt; 25 years</li> <li>• Makes vending purchases about once per month</li> <li>• Purchases from vending machines because of hunger</li> </ul>
Medical Center	<ul style="list-style-type: none"> <li>• Staff or “other” affiliation (possibly patients and visitors)</li> <li>• Age &gt; 25 years</li> <li>• Purchases from vending machines for a snack</li> </ul>

## 5.2 Demographic differences of vending consumers

As might be expected, there was a clear demographic division of consumers: young (18-24 years) students were prevalent in the residence halls and classroom buildings, while older (>25 year) non-students (staff, faculty, and other) were the common patrons in the offices and medical center. Despite this age division, there was no difference in item color purchased by location. Our results corroborate with results from nationally representative surveys, which showed no difference in snack consumption based on age (11).

### 5.3 Factors that influence snack selection

#### 5.3.1 Convenience and Taste

The importance of convenience as a reason for snack vending purchases was demonstrated by survey data and focus group results. The importance of taste when selecting a snack was a salient theme in focus group discussions, but was not apparent in the survey results. Focus group findings showed that student consumers are most likely to use vending machines because of a convenient location of the machine and a convenient form of payment. This supports the survey data which showed that residence hall consumers, who were mostly students (97%), were most likely to report convenience as the reason for purchasing from a vending machine. Focus group participants identified taste as the most influential factor when deciding which snack item to purchase. The importance of taste in snack selection is well-supported by other research findings (15-17). However, this finding was not reflected in the survey results. Only 10.7% of survey responders reported “taste” as the reason for purchase. A possible explanation for this discrepancy was the wording of the survey question. The question asked, “Why do you purchase foods from a vending machine?” The consumer likely responded with his/her reason for choosing a vending machine, as opposed to seeking out another food source. The response does not necessarily explain the factors that influence which snack item the consumer selects once at the vending machine.

#### 5.3.2 Potential impact of point-of-purchase nutrition information

Recent federal legislation mandates the use of menu labeling. Section 4205 of The Patient Protection and Affordable Care Act of 2010, signed into law under the health care

reform legislation, requires restaurants and other retail food establishments with 20 or more locations to display calorie content information for standard menu items on restaurant menus (33). The legislation also applies to vending operators with 20 or more machines and requires that calorie information be posted in the same field of vision as the food items (33). A reason for providing point-of-purchase nutrition information is to correct consumers' misconceptions of the nutrient composition of menu items. Burton (2006) found that consumers significantly underestimate the amount of calories, fat and saturated fat when eating away-from-home, particularly for less-healthy items (34). In a survey of restaurant patrons, customers underestimated calories of less-healthful items by an average of 642 calories; fat was underestimated by an average of 44 grams (34).

Focus group participants reported that if nutrition facts were available at the vending machine, this information would facilitate the selection of healthier snack items. This demonstrates the intention for healthier purchases, but it is unknown how intention would impact actual behavior. Hoerr (1993) found that posting nutrition information on snack vending machines at Michigan State University had no impact on the type of snack selected (23). When interpreting the focus group results, it is important to note that 68% of focus group participants were female. Research shows that females are more likely than males to be concerned with choosing healthy, low-fat snacks (13-15). Focus group discussions may have been biased toward the more health-conscience female perspective due to the higher proportion of female participants.

The Snackwise® nutrition rating system is an abbreviated form of menu labeling that provides consumers with color-coded indications of the most healthy and least healthy snack options (4). Additionally, the availability of less-healthy red items is limited to

28.5%. Despite the reduced availability of these less-healthy options, it was observed that red items accounted for 63% of all observed purchases. It is unknown how this compares with purchasing behaviors prior to Snackwise® implementation. Also, this study did not ask consumers if they recognized or used the Snackwise® designations.

### 5.3.3 Price

According to focus group results, price reduction is one of the major factors that would cause vending consumers to change their purchase. This is consistent with previous studies which showed that lowering prices led to an increase in sales of targeted foods (26-31). Although price reduction may elicit behavior change, it does not appear that current prices are perceived by consumers as an incentive for purchasing foods from vending machines. Survey responders did not mention price as a reason for making vending purchases. As previously discussed, the survey question directed responders toward reasons for coming to the vending machine, rather than reasons for selecting a specific snack food.

### 5.4 Implications

The Ohio State University community could benefit from improving the nutritional quality of snack vending. In all of the vending locations observed during this study, over 60% of consumers purchased snack foods that received the lowest nutritional Snackwise® rating (4). These less healthy snack items are higher in saturated and *trans* fats, sugar, and sodium; and lower in beneficial nutrients such as protein, fiber, iron, calcium, and Vitamins A and C (4). The Dietary Guidelines for Americans are a set of evidence-based nutrition recommendations intended for all Americans ages two years and older (35). According to the Dietary Guidelines for Americans, 2010, solid fats, added



sugars, and sodium are listed as food components to reduce in the diet; potassium, fiber, calcium, and Vitamin D are the nutrients of most concern that should be increased in the diet (35). The majority of vending consumers observed in this study made snack selections that were in direct contrast to the Dietary Guideline recommendations. Despite differences in consumer age, university affiliation, frequency of purchases, and reasons for purchase, the preference for less healthy snack options was consistent across all locations. Therefore, a campus-wide vending policy may have a greater impact than localized interventions. The goal of this policy should be to create a campus environment that helps, rather than hinders, its community members to meet dietary recommendations.

### 5.5 Limitations

There are several limitations in the design of this study. First, the cross-sectional design only provides data for one point in time. This limits the ability to identify temporal trends and creates the potential for seasonal bias. Second, machines were only observed between the hours of 7am and 7pm. Consumers who use vending machines outside of these hours are not represented. This is particularly a concern in the residence halls, which are more likely to have late-night purchases due to the presence of student residents. Third, there was no method for controlling repeat consumers. It is possible that an individual consumer was observed or surveyed multiple times. Fourth, a non-random sample of vending machines was used for the study. Therefore, the results can not be generalized to all campus vending machines.

These results are also limited by potentially biased responses from survey and focus group participants. Male consumers who purchased red items were less likely to participate in the survey, as compared to females or male purchasers of green or yellow

items. As a result, red consumers, particularly male red consumers, were under-represented by survey data. Gender bias may have also existed in focus group discussions. Females accounted for 68% of focus group participants. As previously discussed, there is evidence that males and females may differ in their attitudes toward snacking (13-15). Focus group results may under-represent the male perspective. Finally, because no anthropometric data was collected from survey responders, the results of this research can not be correlated with the incidence of obesity.

## 5.6 Future research

### 5.6.1 Future research at the Ohio State University

Future snack vending research at the Ohio State University should evaluate the effectiveness of the Snackwise® system. This study showed that the proportion of red, yellow, and green items sold does not reflect the proportion available. These results raise questions about the effectiveness of Snackwise®. Do consumers notice the color indicators? Do they understand what the different colors mean? Do they use this information to influence their purchase? A survey of vending consumers may help answer these questions.

Future campus research should also investigate the impact of complete removal of red items. According to survey results, the three most common reasons for purchase were convenience, hunger, and snacking. None of these reasons indicate that consumers are coming to vending machines in search of energy-dense, nutrient-poor foods. If red items are completely removed, will consumers continue to come to vending machines, because it is convenient and they are hungry, but make healthier choices? Finding the answer to this question would have important implications for campus-wide vending policy.

### 5.6.2 Future research in the field of nutrition

On a more broad scale, the field of nutrition should continue to investigate the relationship between snack food consumption and obesity. Similar trends of increased snack consumption and increased rates of obesity have been observed in the U.S. adult population (1-3), but there is no evidence for a causal relationship between snack consumption and obesity.

## References

1. Flegal KM, Carroll MD, Ogden CL, Curtin LR. Prevalence and trends in obesity among U.S. adults, 1999-2008. *JAMA*. 2010;303(3):235-241.
2. Prevalence of overweight, obesity and extreme obesity among adults: United States trends 1960-62 through 2005-06. Center of Disease Control homepage. [http://www.cdc.gov/nchs/data/hestat/overweight/overweight\\_adult.htm](http://www.cdc.gov/nchs/data/hestat/overweight/overweight_adult.htm). January 27, 2010. Accessed March 31, 2011.
3. Piernas C, Popkin BM. Snacking Increased among U.S. Adults between 1977 and 2006. *The Journal of Nutrition* 2010;140(2):325-332.
4. Nationwide Children's Hospital: Center for Healthy Weight and Nutrition. Snackwise® Nutrition Rating System. [www.snackwise.org](http://www.snackwise.org). Accessed May 19, 2011.
5. Caruso, M. Campus based snack food vending consumption. Honors undergraduate thesis. The Ohio State U., 2010. *Knowledge Bank*. Web. 31 March 2011. <<http://hdl.handle.net/1811/45650>>.
6. Johnson GH, Anderson GH. Snacking definitions: impact on interpretation of the literature and dietary recommendations. *Critical Reviews in Food Science and Nutrition*. 2010;50(9):848-871.
7. Zizza C, Siega-Riz AM, Popkin BM. Significant increase in young adult's snacking between 1977-1978 and 1994-1996 represents a cause for concern. *Preventive Medicine*. 2001;32(4):303-310.
8. 2010 Dietary Guidelines Advisory Committee Conclusion Statements. What is the relationship between snacking and body weight in adults? USDA Nutrition Evidence Library. [http://www.nel.gov/evidence.cfm?evidence\\_summary\\_id=250282](http://www.nel.gov/evidence.cfm?evidence_summary_id=250282). Accessed April 30, 2012.
9. Halkjaer J, Tjonneland A, Overvad K, Sorensen TIA. Dietary predictors of 5-year changes in waist circumference. *Journal of the American Dietetic Association*. 2009;109(8):1356-1366.

10. Woo J, Cheung B, Ho S, Sham A, Lam TH. Influence of dietary pattern on the development of overweight in a Chinese population. *European Journal of Clinical Nutrition*. 2008;62(4):480-487.
11. Nielsen SJ, Siega-Riz AM, Popkin BM. Trends in energy intake in U.S. between 1977 and 1996: similar shifts seen across age groups. *Obesity Research*. 2002;10(5):370-378.
12. Glanz K, Basil M, Maibach E, Goldberg J, Snyder D. Why Americans eat what they do: taste, nutrition, cost, convenience, and weight control concerns as influences on food consumption. *Journal of the American Dietetic Association*. 1998;98(10):1118-1126.
13. Grogan SC, Bell R, Conner M. Eating sweet snacks: gender differences in attitudes and behavior. *Appetite*. 1997;28:19-31.
14. Huang YL, Song WO, Schemmel RA, Hoerr SM. What do college students eat? Food selection and meal pattern. *Nutrition Research*. 1994;14(8):1143-1153.
15. French SA, Story M, Hannan P, Breitlow KK, Jeffery RW, Baxter JS, Snyder MP. Cognitive and demographic correlates of low-fat vending snack choices among adolescents and adults. *Journal of the American Dietetic Association*. 1999;99(4):471-475.
16. McIntyre C, Baid A. Indulgent snack experience attributes and healthy choice alternatives. *British Food Journal*. 2009;111(5):486-497.
17. Neumark-Sztainer D, Story M, Perry C, Casey MA. Factors influencing food choices of adolescents: findings from focus-group discussions with adolescents. *Journal of the American Dietetic Association*. 1999;99(8):929-934,937.
18. Story M, Neumark-Sztainer D, French SA. Individual and environmental influences on adolescent eating behaviors. *Journal of the American Dietetic Association*. 2002;S102(3):S40-S51.
19. Brunt AR, Rhee YS. Obesity and lifestyle in U.S. college students related to living arrangements. 2008;51:615-621.
20. Nelson MC, Story M. Food environments in university dorms: 20,000 calories per dorm room and counting. *American Journal of Preventive Medicine*. 2009;36(6):523-526.

21. Seymour JD, Yarock AL, Serdula M, Blanck HM, Khan LK. Impact of nutrition environmental interventions on point-of-purchase behavior in adults: a review. *Preventive Medicine*. 2004;39(S2):S108-S136.
22. Painter JE, Wansink B, Hieggelke JB. How visibility and convenience influence candy consumption. *Appetite*. 2002;38(3):237-238.
23. Hoerr SM, Loudon VA. Can nutrition information increase sales of healthful vended snacks? *Journal of School Health*. 1993;63(9):386-390.
24. Bassett M, Dumanovsky T, Huang C, et al. Purchasing behavior and calorie information at fast-food chains in New York City, 2007. *American Journal of Public Health*. 2008; 98(8): 1457-1459.
25. Buscher LA, Martin KA, Crocker S. Point-of-purchase messages framed in terms of cost, convenience, taste, and energy improve healthful snack selection in a college foodservice setting. *Journal of The American Dietetic Association*. 2001;101(8):909-913.
26. Jeffery RW, French SA, Raether C, Baxter JE. An environmental intervention to increase fruit and salad purchases in a cafeteria. *Preventive Medicine*. 1994;23(6):788-792.
27. Cinciripini PM. Changing food selections in a public cafeteria: An applied behavior analysis. *Behavior Modification*. 1984;8(4):520-539.
28. Michels KB, Bloom BR, Riccardi P, Rosner BA, Willett WC. A study of the importance of education and cost incentives on individual food choices at the Harvard School of Public Health cafeteria. *Journal of the American College of Nutrition*. 2008;27(1):6-11.
29. French SA, Jeffery RW, Story M, Hannan P, Snyder P. A pricing strategy to promote low-fat snack choices through vending machines. *American Journal of Public Health*. 1997;87(5):849-851.
30. French SA, Jeffery RW, Story M, Breitlow KK, Baxter JS, Hannan P, Snyder MP. Pricing and promotion effects on low-fat vending snack purchases: the CHIPS study. *American Journal of Public Health*. 2001;91(1):112-117.
31. French SA, Hannan PJ, Harnack LJ, Mitchell NR, Toomey TL, Gerlach A. Pricing and availability intervention in vending machines at four bus garages. *Journal of Occupational and Environmental Medicine*. 2010;52(1S):S29-S33.
32. Patton MQ. Qualitative evaluation and research methods (2<sup>nd</sup> ed). Newbury Park, CA: Sage. 1990.

33. U.S. Department of Health and Human Services: FDA Labeling and Nutrition. New menu and vending machine labeling requirements. FDA website. <http://www.fda.gov/Food/LabelingNutrition/ucm217762.htm>. April 6, 2011. Accessed May 17, 2011.
34. Burton S, Creyer EH, Kees J, Huggins K. Attacking the obesity epidemic: the potential health benefits providing nutrition information in restaurants. *American Journal of Public Health*. 2006;96(9):1669-1675.
35. U.S. Department of Agriculture and U.S. Department of Health and Human Services. *Dietary Guidelines for Americans, 2010*. 7<sup>th</sup> Ed, Washington, DC: U.S. Government Printing Office, December 2010.

## Appendix A: Intercept Survey

### Purchase Demographics

Time of Purchase: \_\_\_\_\_

Vending Machine Location \_\_\_\_\_

### Observable Data

(Circle One / Write In)

1. Gender:                      Male                      Female

2. Item Purchased: \_\_\_\_\_

Will Consumer Participate in Questionnaire?    Yes                      No  
If Yes:

### Intercept Survey

(Write In Answers of Respondents)

1a. What is your affiliation to the University? (Circle one)

Student Staff                      Faculty                      Other (write in) \_\_\_\_\_

1b. If Staff:

Medical Staff                      Non-medical Staff

2. How frequently do you make vending machine purchases? (Check one)

\_\_\_\_ More than 3 times/week                      \_\_\_\_ 1 – 3 times/week

\_\_\_\_ 2 times/month                      \_\_\_\_ 1 time/month

\_\_\_\_ Less than 1 time/month                      \_\_\_\_ Unknown

3. Why do you purchase foods from a vending machine? (write in)

\_\_\_\_\_.

4. How old are you? (circle one)

18-24                      25-35                      35-45                      45-55                      55+                      Unknown



## Appendix B: Intercept Survey Consent Script

Hello my name is [Interviewer's name] and I am a student working with the Department of Human Nutrition researching vending machine use on campus. I would like to ask you 5 quick questions about your purchase. The information you share with me will be very valuable in helping me to complete this research project. No personal information or identifiers will be collected from you. Participation is voluntary and you are free to decline participation or stop participating at any time. Do you agree to participate?

### Appendix C: Email Collection Consent Script

Thank you for your participation in the survey. We will be conducting focus groups and interviews to learn more about vending consumers on campus. Participation is strictly voluntary. May I have your email address to contact you about future opportunities to participate in focus groups or interviews?

## Appendix D: Email Collection Form

Date:

Location:

EMAIL ADDRESS	ITEM PURCHASED
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	

## Appendix E: Focus Group Recruitment Email

As a graduate student in the Department of Human Nutrition, I would again like to thank you for your recent participation in a research study examining the use of snack vending machines on campus. During a survey, you indicated that you would be interested in further participation in this research by being part of a focus group. The focus group will be a facilitated conversation among 6-8 individuals in which you will be invited to share your personal experience and views about your use of vending machines on campus. Participation is voluntary and involves a one-time commitment of about 90 minutes. The focus groups will be conducted during the weeks of May 16-20 and May 23-27 between the hours of 5pm and 9pm in Campbell Hall 350A. You will be compensated for your time by a \$20 Target gift card and refreshments during the focus group. If you are interested in participating please contact Anne Klapheke at [klapheke.1@osu.edu](mailto:klapheke.1@osu.edu).

## Appendix F: Focus Group Recruitment Flyer

# We want to know more about your vending machine purchase!

Researchers in the Department of Human Nutrition at the Ohio State University are conducting a study about the use of campus vending machines. You are invited to participate in a focus group to share your views and experiences of purchasing food from vending machines on campus.

**Participation:**

- One-time commitment of 90 minutes
- Join in a facilitated group discussion with 5-7 other vending machine consumers

**When:**

- May 16-27, 2011 between the hours of 5pm and 9pm

**Where:**

- Campbell Hall, The Ohio State University

**Compensation:**

- \$20 Target gift card
- Refreshments

**To sign up, please contact Annie by Friday May 20th**  
**Annie Klapheke, research co-investigator; [klapheke.1@osu.edu](mailto:klapheke.1@osu.edu)**

\$20 to Target, Vending Study  
[klapheke.1@osu.edu](mailto:klapheke.1@osu.edu)

\$20 to Target, Vending Study  
[klapheke.1@osu.edu](mailto:klapheke.1@osu.edu)

\$20 to Target, Vending Study  
[klapheke.1@osu.edu](mailto:klapheke.1@osu.edu)

\$20 to Target, Vending Study  
[klapheke.1@osu.edu](mailto:klapheke.1@osu.edu)

\$20 to Target, Vending Study  
[klapheke.1@osu.edu](mailto:klapheke.1@osu.edu)

\$20 to Target, Vending Study  
[klapheke.1@osu.edu](mailto:klapheke.1@osu.edu)

\$20 to Target, Vending Study  
[klapheke.1@osu.edu](mailto:klapheke.1@osu.edu)

\$20 to Target, Vending Study  
[klapheke.1@osu.edu](mailto:klapheke.1@osu.edu)

\$20 to Target, Vending Study  
[klapheke.1@osu.edu](mailto:klapheke.1@osu.edu)