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THE HEALTHFULNESS OF ENTRÉES AND STUDENTS' PURCHASES IN THE CAMPUS DINING ENVIRONMENT

BY

KRISTA LEISCHNER

A thesis submitted in partial fulfillment of the requirements for the

Master of Science

Major in Nutrition, Exercise, and Food Science

Specialization in Nutritional Sciences

South Dakota State University

2016

THE HEALTHFULNESS OF ENTRÉES AND STUDENTS' PURCHASES IN THE CAMPUS DINING ENVIRONMENT

This thesis is approved as a creditable and independent investigation by a candidate for Master of Science in Nutrition and Exercise Sciences degree and is acceptable for meeting the thesis requirements for this degree. Acceptance of this thesis does not imply conclusions reached by the candidate are necessarily the conclusions of the major department.

Kendra Kattelmann, Ph.D., RDN, LN — Date
Thesis Advisor

Matthew Vukovich, Ph.D. — Date
Head, Department of Health and Nutritional Sciences

Dean, Graduate School — Date

ACKNOWLEDGEMENTS

The saying, “Alone we can do so little; together we can do so much” applies to many situations in life, but I have found it is particularly applicable to my time spent pursing my master’s degree at South Dakota State University. I would like to thank my advisor, Dr. Kendra Kattelmann for her encouragement, leadership, and never-ending support. She has not only helped me grow as a professional, but more importantly, as a person. Her passion for the field of nutrition research is contagious and I hope to someday positively impact people the way she has impacted me.

I would also like to thank Dr. Lacey McCormack, Dr. Brian Britt, Dr. Greg Heiberger, and Dr. Geoffrey Henebry for serving on my graduate committee. I appreciate their constant guidance through the development of this study and willingness to assist in the statistical analyses and to provide feedback throughout the writing process.

Lastly, I would like to thank my family. First, my mother and father, Teri and Joe, who engrained Jackrabbit pride in me at a young age, who love me unconditionally, and who taught me at a young age the importance of hard work and dedication. Second, my husband, Luke, who originally encouraged me to pursue my master’s degree and who has run alongside me through this journey, cheering me on at every step!

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ABSTRACT

THE HEALTHFULNESS OF ENTRÉES AND STUDENTS' PURCHASES IN THE CAMPUS DINING ENVIRONMENT

KRISTA LEISCHNER

2016

The purpose of this study is to determine the availability of "more" versus "less healthful" entrée items in the campus dining environment and also to determine if students' purchases are reflective of what is offered.

Entrée items were categorized as either "more" or "less healthful" according to the American Heart Association guidelines. Students' entrée purchases from the 2014-2015 school year were analyzed at a Midwestern university. The relationship between students' demographics and food purchases was also analyzed in this observational study.

Significant differences between more healthful and less healthful purchased and available items were determined using a Chi-square test. A Chi-square test was also used to determine if the proportion of purchased more healthful and less healthful entrées differed between the fall and spring semesters. Logistic regression was used to determine the effect of demographics on more healthful and less healthful purchases in the fall versus spring semesters.

The majority of the entrée items available in the campus dining environment were considered less healthful (85.04%) while only a small percentage were considered more healthful (14.95%). The purchased entrée items significantly differed from what was available in both the fall (X^2 = 14,028.40, df = 1, p <0.0001) and spring (X^2 = 7,192.13, df = 1, p < 0.0001) semesters. The proportion of more healthful and less healthful entrees

purchased differed between the fall and spring semesters ($X^2 = 133.98$, df = 1, $p < 0.0001$). Gender was the only demographic variable predictive of MH entrée purchases in both semesters; females were more likely to purchase more healthful options than males in the fall (OR = 2.23, 95% CI [2.14, 2.23]) and spring (OR = 2.42, 95% CI [2.31, 2.54]) semesters.

The campus dining environment consisted of primarily less healthful entrées and students' purchases were primarily less healthful. Future research ought to work with campus dining providers to create profitable, yet healthful, campus dining environments. Obesity prevention efforts at the college level should start immediately in the fall and emphasize improving males' dietary intake.

CHAPTER 1

Introduction

Obesity has reached record levels and presents a major public health threat. Roughly one in three people nationally are currently obese and the bodyweight of an average American adult increases at a rate of 0.9 kg (1.98 lbs.) per year.[1,2] An obese adult is defined as one with a body mass index (BMI) of greater than or equal to 30; BMI is measured by the ratio of mass in kilograms to height in meters squared.[3] Adult obesity is related to severe health consequences. This disease is detrimental to one's current health and also leads to complications in future well-being. Possible chronic health concerns resulting from obesity include stroke, sleep apnea, coronary heart disease, hypertension, type 2 diabetes, and dyslipidemia.[4]

Unhealthy behaviors, such as decreased physical activity levels, increased sedentary time, and poor dietary intake develop during childhood and can, continue through adolescence into adulthood;[5] a significant proportion of obese adults were previously obese as young adults (18-25 years).[5,6] Specifically, young adults who attend college have been shown to gain between 1.8 and 4.1kg (3.96-9.03 lbs.) annually.[1] Unhealthy weight gain can occur as a result of fluctuations in eating and exercise habits. The often stressful transition from home to college for many young adults can trigger alterations from a normally healthy lifestyle routine to one that promotes the onset of obesity.[7] Such lifestyle modifications, influenced by environmental, occupational, and behavioral changes typically include increased academic stress, increased alcohol intake, decreased physical activity, irregular sleep patterns, and poor dietary behaviors.[7,8] When combined with personal and environmental barriers, these lifestyle modifications can

increase one's risk for the development of obesity. Personal barriers may include a student's lack of self-control when eating and a lack of motivation to increase healthful habits. An environmental barrier and the focus of this research, is the college dining environment and its effect on students' unhealthful food purchases and dietary behaviors.

Elements common to the campus dining environment that may negatively affect dietary behaviors include a lack of availability to, and increased prices of, healthful food options and required campus meal plans. On-campus dining facilities can be fast and convenient options that cater toward students' busy school, social, and work schedules. Although campus dining can be quick and easy, all too often unhealthy fast food, oversized portions, and "all-you-can-eat" options are the norm.[9] Understandably, this environment can lead to excess energy consumption.[9]

While previous studies have linked excess energy consumption to college student weight gain, there is a gap in the literature measuring the healthfulness of the campus dining environment and students' purchases. Therefore, the purpose of this study is to determine the availability of "more" versus "less healthful" entrée items in the campus dining environment and also to determine if students' purchases are reflective of what is offered. It is hypothesized that a higher availability of unhealthy foods will reflect a greater percentage of unhealthy foods purchased.

CHAPTER 2
Literature Review

A literature review was conducted to better understand barriers to healthful behaviors and factors leading to weight gain among college students. In the review, obesity, its prevalence, effect throughout the lifecycle, college lifestyles, and the college-dining environment were all addressed.

The Severity of Obesity

Approximately one in three American adults are obese.[2] Obesity is defined as a body mass index (BMI) of ≥ 30.[2,10] Overweight or obesity, defined as a BMI of ≥ 25 impacts over 144 million (66%) of Americans adults 20 years or older.[11] Obesity can increase one's risk of a variety of comorbid conditions including: hypertension, dyslipidemia, certain cancers, type 2 diabetes mellitus, and heart disease, the nation's leading cause of death.[12,13] Obesity is not to be taken lightly and the severity is reflected in the creation of further classifications of the disease; a BMI of 30-34, 35-39, and ≥ 40 are classified as grade 1, grade 2, or grade 3 obesity, respectively.[2] According to the 2009-2010 National Health and Nutrition Examination Survey (NHANES), the combined prevalence of grade 2 and grade 3 obesity (BMI of 35 and above) in Americans over the age of 20 totaled 15.5%.[14] With high prevalence it is not surprising that approximately 147 billion dollars were spent in 2008 on obesity related health concerns.[15] This public health crisis is not limited to solely the United States, but is instead a worldwide epidemic[16] and the World Health Organization (WHO) states the obesity epidemic is not limited to developed countries.[17] According to Lim et al. in 2010, 3.4 million individuals died worldwide from obesity and its related health concerns.[18] Humans of all ages and

from all areas of the world suffer from obesity, making the history and causes of this disease worth discussing.

The History of Obesity

The history of obesity originates thousands of years ago. Chronic food shortages created environments with few options among the feasting, rich and famine enduring, poor.[16] New data is constantly presented in this ever-growing field of study as researchers continue to study monogenic obesity including rare forms of the disease and polygenic obesity encompassing common forms of obesity.[19] Evolutionarily, when an excess of food was present, the human body stored this excess energy supply for future use and ultimately, survival. This hypothesis, known as the "thrifty genotype hypothesis," implies increased energy intake leads to variation in genes in order for humans to survive when there is no food present.[20]

One of the leading causes of weight gain is an imbalance of energy intake and expenditure over a sustained period of time, leading to an overall net positive energy balance. Food and drink taken into the body are considered energy intake and energy lost through breathing, digestion, and physical activity is considered energy expenditure. A model based on the First and Second Laws of Thermodynamics to predict weight gain from the imbalance of energy was created.[21] This model states the body will produce changes in weight and composition if a long-term change in energy intake or energy expenditure occurs.[21] Although the development of agriculture (approximately 14,000 years ago) allowed humans to eat more regularly, humans still consumed fewer calories while expending a significantly larger amount of energy compared to today's society.[22] It was not until the 1960's that the food supply was radically changed and unhealthy foods

were fast and easy to obtain.[22] The United States' technologically advanced and consumerist society combined with an evolutionary heritage has contributed to the obesity epidemic.[22]

Obesity Throughout the Lifecycle

Obesity is known to increase morbidity and mortality throughout the lifecycle.[23] The risk of being an obese adult is influenced prenatally, during infancy, childhood, and young adulthood. A review by Brisbois et al. identified early markers of the disease, looking at the most significant predictors of adult obesity and focusing on the importance of the prenatal period.[24] Parents play a significant role in a child's development of obesity. Brisbois and colleagues identified low parental socioeconomic status, gestational exposure to smoke, gestational diabetes, and unhealthy weight gain before and during pregnancy as factors increasing a child's chances of developing obesity.[24] Premature delivery and unhealthy birth weights along with the absence of breastfeeding were identified as early markers of adult obesity in infancy.[24] Infants breastfed exclusively for the first four months of life and then as the sole source of milk until 12 months and formula fed infants were compared in the DARLING study by Dewey.[25] Breastfeeding and its' protection against childhood obesity was examined. The results revealed an increase in fatness among both groups during the first 6 months with the breastfed group losing weight more quickly thereafter.[25]

Continuing through the lifecycle, one in three youth (between 2-19 years) are obese.[11] An overweight or obese child is at an increased risk for health conditions not only in their youth, but also as an adult.[26] The American Heart Association (AHA) states that overweight children have a 70-80% increased risk of remaining overweight as an

adult; understandably, it has been said that childhood obesity is "one of the most pressing health threats facing the United States."[11,26] Obesity is measured differently in children than it is in adults; a child is classified as obese with a BMI at or above the 95th percentile.[27] According to Kuczmarski et al., the percentiles express a child's BMI relative to data from national surveys of other U.S. children.[28] Along with lack of sleep, high exposure to television, and an unhealthy diet,[24] genetics has been shown to influence one's development of childhood obesity.[22]

Similar to the multi-factorial causes of obesity, the additional physical and psychological issues associated with obesity are also complex and widespread. In addition to an increased risk of obesity as an adult, an overweight child is commonly at higher risk for cardiovascular disease as it has been shown that a diagnosis of an additional cardiovascular disease risk factor is common.[29] Examples of additional cardiovascular disease risk factors include elevated blood pressure and increased low-density lipoprotein (LDL) cholesterol.[29] According to the 2014 World Health Organization (WHO) statistics, psychological issues can also trace into the future and children suffering from obesity are more susceptible to the development of a lack of self-confidence, distorted body image, and eating disorders.[29,30] The emotional issues developed as a child may be carried throughout life as a young adult and eventually into adulthood.

College Students and Obesity

Young adults have been defined as individuals anywhere between the age of 18 and 29 years.[31] Young adults are at a particularly high risk for developing obesity, especially those attending college and between 18-24 years.[32] College attendance is

common to American young adults as approximately 24 million students attended college in 2011, according to the United States Census Bureau.[33] A substantial amount of data were collected on this age group through the ACHA-National College Health Assessment II (ACHA-NCHA II) survey, which was conducted by the American College Health Association (ACHA). The ACHA-NCHA II is the largest known research survey for college students, providing a relevant and reliable dataset for this population. A significant number of young adults do not meet recommended nutritional guidelines; the spring 2014 ACHA-NCHA II survey determined of the nearly 80,000 students surveyed, 93.5% did not consume the recommended five fruits and vegetables per day.[34] Not surprisingly, of the young men and women surveyed, 34.6% reported a BMI of ≥ 25 and were considered either overweight or obese.[34]

Healthy People 2020 (HP2020) aims to increase health promotion and decrease disease in the United States via 10-year national goals.[35] HP2020 focuses on 26 leading health indicators, including "nutrition, physical activity, and obesity." These comprehensive goals cover all age groups, children, adolescents, young adults, and adults. The targets regarding "nutrition and obesity," for these age groups include decreasing the number of obese adults and adolescents and increasing mean daily intake of total vegetables.[35] As of March 2014, there was little or no deducible change in these areas,[35] exemplifying the need for additional research on the unhealthy lifestyles among young adults, especially college students.

The Freshman 15 refers to the weight gain attributed to increased energy intake and decreased physical activity common to the first year of college.[36,37] This term is a rather ominous descriptor of physical changes that students in their first year of college

often exhibit; however, the number fifteen may be more correctly coined the "Freshman 5 or Fewer". A review by Vella-Zarb and Elgar calculated the mean weight gain during the freshman year from 24 journal articles focusing on this topic. Out of 3,401 freshmen, the average weight gain (from both self-reported and measured height and weight) was 3.86lbs.[38] Agreeing with other research, a study by Hoffman et al. determined freshmen actually gain only 33% of the dreaded Freshman 15.[39]

Debunking the myth that freshmen gain 15 pounds during their first year of college is important; however, the weight gained during freshmen year ought to still be taken seriously as it is a serious contributor to obesity later in life.[36] It has been shown the weight gained in the first year of college is often maintained or added to. Hoffman et al. pointed out, if a positive energy balance is maintained students could potentially gain 27lbs after four years of college.[39] Small changes in dietary and physical activity behaviors over a long period of time may produce significant changes in weight.[39] Similarly, Levitsky et al. explained participants gained an average of 158g/week and this might not appear as a significant amount; however, this is equivalent to a daily increase of 174kcal/day and if not combatted with an increased amount of physical activity, can considerably impact weight gain.[9]

The weight gained during the first year of college proves dangerous and an even more significant negative effect due to the difficulty in returning to a healthy weight. In addition, overweight or obese first year students have been shown to be overweight or obese upon graduation and as adults.[36] A recent study by Nicoteri et al. discovered 25.6% of students were overweight and obese at the beginning of college and 32% of students were overweight and obese when they graduated.[36]

Dietary Behaviors and Predictors of Weight Gain

It has been established college students tend to gain weight during the first year of college.[7] Although an important aspect, the previous fact is useless in the fight against obesity unless researchers determine why students gain weight and intervene in those places. Crombie et al. summarized the factors influencing weight gain using a simple energy balance equation showing the relationship between energy input and energy output; these factors are furthered reviewed below.[7]

Holm-Denoma et al. used self-reported weight during the senior year of high school and end of freshmen year of college to study the predictors of freshmen weight gain. This large sample of men (n=266) and women (n=341) showed a significant amount of weight gain and absence of significant increase in height among both males (3.5lbs) and females (4.0lbs). The predictors of weight gain determined in this study differ from that of previous research as Levitsky et al. determined consuming late night snacks and eating in all-you-can-eat dining facilities as significant predictors of weight gain.[10] The regression analyses by Holm-Denoma et al. revealed participants' predictors of weight gain were not related to dietary behaviors. Instead, a male's relationship with his parents and his level of exercise and participation in competitive sports predicted weight gain. The only predictor of weight gain among women from high school to college was her relationship with her parents; that is, women who said they were satisfied with their relationship with their parents or who had parents who were uncritical were more likely to gain weight.[40] This study is a prime example of the complexity of factors related to excess weight gain during the freshman year and demonstrates the importance in further researching these predictors.

Teenagers transitioning into college may also gain weight and be at risk for unhealthy behaviors due to a lack of knowledge of nutrition, human physiology, energy metabolism, and genetics in relation to weight gain. The nutritional and physiological knowledge of a high school student transitioning into college may be lacking and therefore when combined with an unhealthy environment may lead to future weight gain. A study by Matvienko et al. provided a college-level science-based course to first or second year female college students with no previous nutrition course. It is important to note that the students in both intervention and control groups demonstrated virtually zero knowledge relating to energy metabolism and expenditure at baseline. The small sample size (n=40) and self-selected participants are significant limitations of this study, however there were a few results of this study that play an important role in determining predictors of weight gain among this age group worth noting. Students in the course (intervention group) maintained their weight, improved knowledge relating to nutrition, energy metabolism, and energy balance, and reported after one year higher retention of complex concepts relating to energy balance compared to students who did not take the course (control group). This study differed from past research investigating the impact of nutrition education on obese individuals because non-obese students were included, but is similar to previous conclusions stating the importance of education in weight maintenance and prevention of weight gain among first year college students.[41]

The transition from home to the college lifestyle presents young adults with many new challenges. Each student reacts to their situation differently[42] and transitioning from home to college has been shown to increase the risk for weight gain.[43] Increased academic stress has been shown to lead to stress-eating as the body reacts

psychologically (versus physiologically) to these triggers.[44] Stress-eating has been shown to lead to a decreased consumption of healthy foods and increased intake of sweet foods and mixed dishes, such as candy and pizza.[45] An increased appetite and a lack of regard for healthy eating in combination with the inability to cope with stress can contribute to unhealthy behaviors and weight gain.[44-46]

The adjustment from living with parents and siblings at home to living with a roommate(s) in a dormitory on campus is a major environmental change. Students transitioning into college experience a 180-degree shift as they move into a new location with completely new surroundings. Drastic changes in routine and responsibilities and an increase in academic stress in combination with new environmental surroundings, such as new dormitory living, can trigger excess weight gain.[44] The environment, in which one lives and works is most often chosen by the individual, except for first-year college students that are assigned dormitories. Kapinos and Yakusheva studied the effect of randomly assigned physical environments relating to dining and physical activity on campus among 1,057 students. These researchers determined females and males living in a dormitory with an on-site dining facility were more likely to exhibit poor dietary behaviors; females weighed more and males snacked more than those who did not have access to an on-site dining facility.[47] Nelson and Story examined the food and beverages in 100 students' dormitories (83% were first year students) and discovered on average students' had nearly 23,000 calories in their dorm rooms. The items were shown to be purchased by either the participant or their parents with those items purchased by parents showing to be higher in calories and total fat percentage (130.6 calories and 28.5%) than those purchased by students (119.3 calories and 20.0%). The study also recorded self-

reported dietary practices and determined a correlation between a higher amount of healthy or unhealthy food and beverages contributed to a higher consumption of that food and beverage. For example, those who had an average of seven sugar-sweetened beverages consumed at least one sugar-sweetened beverage per day. On the contrary, those who had an approximately 4 sugar-sweetened beverages consumed less than one sugar-sweetened beverage per day.[48]

The Social Ecological Model (SEM) supports the multiple influences involved in changes and dietary behaviors leading to weight gain among freshmen. The SEM is a program-planning framework suggesting there are multiple influences impacting an individual's dietary behaviors. The four levels of the SEM described in a review by Story and researchers include: 1) interpersonal: including an individual's personal factors, such as cognitions, skills, behaviors, lifestyle, and demographics, 2) intrapersonal: including an individual's social environment, such as family, friends, and peers, 3) community: including the environment in which one exists such as home, work, school, restaurants, and grocery stores, and 4) societal factors such as cultural norms, food and beverage industries, food assistance programs, health care systems, and food marketing.[49] Obesity prevention interventions using the ecological approach have been shown to have a more significant impact while spending less money.[50] Past research attempts to address the levels of the SEM influencing college students' dietary behaviors include a study by Greaney et al. This study's online focus groups found intrapersonal barriers to healthful weight management to include a lack of exercise and discipline, low consumption of healthful foods, and high levels of boredom and stress. The only significant barrier reported at the interpersonal level stemmed from pressures to eat (unhealthy and over

portioned foods) in social settings. Lastly, students confirmed a variety of previously determined environmental barriers to living healthy in college such as: time constraints associated with being a student, lack of healthy foods served at dining facilities, easy access to unhealthy foods and fast-food restaurants, and expensive healthful options.[50]

Nelson and researchers' study also used small focus groups. Key conclusions from this study support the previous research regarding environmental factors (campus dining); students stated all-you-can-eat buffets encouraged poor dietary behaviors and many were unaware they were consuming unhealthy foods due to a lack of available nutrition information.[51] A significant portion of research regarding determinants of eating behaviors among young adults includes quantitative studies; few studies have collected qualitative data regarding students' perceived determinants of healthy behaviors. Although a small number of participants, these in-person focus group discussions with first and second year college students provide essential first-hand insight regarding the factors associated with college weight gain relating to campus dining.

Dining Facilities

Dining facilities fall into both the third and fourth levels of the SEM: community and societal factors. The food environment on a college campus while taking multiple considerations into account, besides simply feeding students, must acknowledge the potential to highly impact the dietary behaviors of college students.[52] College students leave their homes and form new lifestyle patterns. Dietary behaviors formed at this developmental period can either promote a healthy lifestyle or the opposite, lead to excess weight gain. For these reasons, campus dining plays a significant role in obesity prevention/promotion.[53] Foodservice providers ought not view their crucial role in

supporting college students' healthful food behaviors as daunting, but instead in a positive light. Acknowledgement of this plays a vital role in establishment of sustainable environmental changes on campus.[52] As first-year students are required to purchase a meal plan, the majority of students' food purchases are made at on-campus dining facilities; campus dining may have a negative connotation to some, but it's important to state that on-campus dining venues have been established as healthier than off-campus dining venues.[52] Even the smallest changes on a campus can significantly impact college students' weight gain such as: increasing healthy food and drink options, increasing facilitators of healthy eating, and decreasing barriers that promote obesity.[52]

Campus dining providers aim to make profit and may offer unhealthy options believing this is what individuals want to purchase; however, research points toward the opposite. For example, a study by Freedman et al. determined, of the total participants (n=806), 62% worked on campus 5 days/week.[54] Only 23% of these employees ate lunch 5 days/week on campus due to reasons such as lack of satisfaction with food choices, fruit and vegetable availability, and the number of places to eat on campus.[54] This study addresses the food provider's concern- offering healthy foods and not making a profit. The responses to the question, "What would induce you to purchase more food frequently on campus?" may surprise food providers as participants answered the opposite as to what is currently offered stating they would like: different food choices (71%), on-campus farmers market (58%), and more places to purchase food (53%).[55] The campus dining experience could also be improved and encourage students to make healthier choices through the use of nutrition labeling. A significant reason nutrition labels are not commonly present on food available in a campus-dining setting is because food providers

do not want to risk decreased sales.[55] The thought process behind this being, if the nutrition information is available to students, they may decide to purchase less unhealthy foods, and if there are not enough healthy options available, sales will drop. A study by LaCaille and researchers examined the determinants of eating and physical activity among a small focus group of undergraduate students (n=49).[43] Although a small sample size, the determinants of eating behavior relating to campus dining were consistent with that of others studies and focused on the perceived lack of availability of healthful foods on campus.[43]

One change in the dining environment that has been shown to positively impact dietary behaviors is providing nutritional information on food items. Researchers at a mid-western college set out to determine the impact of provided nutrition information (presented as "Nutrition Bytes") in university dining halls and differences among men and women using the provided nutritional information. This study found of the 205 total subjects, 120 users stated the top three reasons for using the nutrition labels among both sexes were: 1) general knowledge, 2) concern about overall health, and 3) concern about certain nutrient(s). The significant reason for those who did not use the nutrition information (n=85) was that the nutrition information would not change the participant's mind and they would eat the food regardless. A significant portion of the sample were freshmen or sophomores (61%) and shows this age group would appreciate nutrition information.[56]

This literature review was conducted to further understand the barriers to healthful behaviors and factors leading to unwanted weight gain among college students.

This review supports the hypothesis stating the healthfulness of the foods offered in the campus dining environment may relate to college students' purchases.

CHAPTER 3
MANUSCRIPT
ABSTRACT: The Healthfulness of Entrées and Students' Purchases in the Campus Dining Environment

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Objective: The purpose of this study is to determine the availability of "more" versus "less healthful" entrée items in the campus dining environment and also to determine if students' purchases are reflective of what is offered.
Design: Entrée items in the campus dining environment were categorized as either "more" or "less healthful" according to the American Heart Association guidelines. Students' individual purchases of the available entrée items at a Midwestern university were analyzed. The relationship between students' demographics and food purchases was also analyzed in this observational study.
Variables Measured: Entrée purchases, students' demographics (permanent address, Expected Family Contribution, ethnicity, race, and gender)
Analysis: Chi-square tests were used to determine significant differences between purchased and available more healthful and less healthful items and whether the proportion of more healthful and less healthful entrées purchased differed between the fall and spring semesters. Odds ratio estimates were used to determine the differences between the demographics and more healthful and less healthful purchases in the fall versus spring semesters.
Results: The majority of the entrée items available in the campus dining environment were considered less healthful (85.04%) while only a small percentage were considered more healthful (14.95%). The purchased entrée items significantly differed from what was available in both the fall (X^2 = 14,028.40, df = 1, p <0.0001) and spring (X^2 = 7,192.13, df = 1, p < 0.0001) semesters. The proportion of more healthful and less healthful entrees purchased differed between the fall and spring semesters (X^2 = 133.98, df = 1, p < 0.0001). Gender was the only demographic variable predictive of MH entrée purchases in both semesters; females were more likely to purchase more healthful options than males in the fall (OR = 2.23, 95% CI [2.14, 2.23]) and spring (OR = 2.42, 95% CI [2.31, 2.54]) semesters.
Conclusions and Implications: The campus dining environment consisted of primarily less healthful entrées and students' purchases were primarily less healthful. Future research ought to work with campus dining providers to create profitable, yet healthful, campus dining environments. Obesity prevention efforts at the college level should also start immediately in the fall and emphasize improving males' dietary intake.

The Healthfulness of Entrées and Students' Purchases in the Campus Dining Environment

Introduction

Obesity has reached record levels and presents a major public health threat. Roughly one in three people nationally are currently obese and the bodyweight of an average American adult increases at a rate of 0.9 kg (1.98 lbs.) per year.[1,2] An obese adult is defined as one with a body mass index (BMI) of greater than or equal to 30; BMI is measured by the ratio of mass in kilograms to height in meters squared.[3] Adult obesity is related to severe health consequences. This disease is detrimental to one's current health and also leads to complications in future well-being. Possible chronic health concerns resulting from obesity include stroke, sleep apnea, coronary heart disease, hypertension, type 2 diabetes, and dyslipidemia. [3,4]

Unhealthy behaviors, such as decreased physical activity levels, increased sedentary time, and poor dietary intake develop during childhood and can, continue through adolescence into adulthood;[5] a significant proportion of obese adults were previously obese as young adults (18-25 years).[5,6] Specifically, young adults who attend college have been shown to gain between 1.8 and 4.1kg (3.96-9.03 lbs.) annually.[1] Unhealthy weight gain can occur as a result of fluctuations in eating and exercise habits. The often stressful transition from home to college for many young adults can trigger alterations from a normally healthy lifestyle routine to one that promotes the onset of obesity.[7] Such lifestyle modifications, influenced by environmental, occupational, and behavioral changes typically include increased academic stress, increased alcohol intake, decreased physical activity, irregular sleep patterns, and poor dietary behaviors.[7,8] When combined with personal and environmental barriers, these lifestyle modifications can

increase one's risk for the development of obesity. Personal barriers may include a student's lack of self-control when eating and a lack of motivation to increase healthful habits. An environmental barrier and the focus of this research, is the college dining environment and its effect on students' unhealthful food purchases and dietary behaviors.

Elements common to the campus dining environment that may negatively affect dietary behaviors include a lack of availability to, and increased prices of, healthful food options and required campus meal plans. On-campus dining facilities can be fast and convenient options that cater toward students' busy school, social, and work schedules. Although campus dining can be quick and easy, all too often unhealthy fast food, oversized portions, and "all-you-can-eat" options are the norm.[9] Understandably, this environment can lead to excess energy consumption.[9]

While previous studies have linked excess energy consumption to college student weight gain, there is a gap in the literature correlating the availability of less healthful foods and student purchases. Therefore, the purpose of this study is to determine the healthfulness of the entrée items and students' purchases in the campus dining environment. It is hypothesized that a higher availability of unhealthy foods will reflect a greater percentage of unhealthy foods purchased.

Methods

Study Design

This observational study took place at a Midwestern university and used students' identification (ID) card data, which included demographic information and purchased food items from the 2014-2015 school year. Institutional Review Board (IRB) approval

(#IRB-1411005-EXP) was obtained in accordance with the policy statements of the Human Subjects Committee at SDSU.

Students individually chose their meal plans at the beginning of the school year and used their student ID cards to make all on-campus food purchase during the fall 2014 and spring 2015 semesters; therefore, the data collected from the student ID cards were used to monitor individual food purchases throughout the school year. The relationship between students' demographics (hometown degree of ruralness/rurality, Expected Family Contribution, race and ethnicity, and gender) and their MH food purchases using odds ratios were explored. Higher odds ratios indicated when individuals within the specified groups purchased an entrée, it was more likely to be MH.

Students' permanent addresses were used to determine the degree of ruralness/rurality of their home living environment. Students' zip codes were converted to counties using "Complete Zip Code Totals File" from the United States Census Bureau.[57] Each county was then assigned a Rural-Urban Continuum Code (RUCC) of one through nine based on the population and proximity to a metro area. Counties assigned an RUC code of 8 or 9 were considered "completely rural or less than 2,500 urban population and adjacent to a metro area" and "completely rural or less than 2,500 urban population and not adjacent to a metro area," respectively. For the purposes of this study, RUC codes 8 and 9 were considered "completely rural" and RUC codes of 1-7 were considered "not as rural." It might also be noted that international students were excluded as their residence could not be assigned a code. The Expected Family Contribution (EFC) served as a proxy for the students' socioeconomic status. This linear variable measured the financial strength of the student's family (family affluence); as the

EFC increases, affluence of the family increases.[58] Gender, race, and ethnicity used in this study were from the Integrated Postsecondary Education Data System (IPEDS) and included the following: male, female, Alaskan Native, American Indian, Asian, Black or African American, White, Hispanic or Latino, Multi-Racial, and Unknown.

Food Items

A list of food items available for purchase was obtained from the campus-dining provider and classified as entrées, snack foods and side dishes, drinks, or other. This study is limited to entrées and the following categories of foods were considered entrées: Burger, Entrée Salad No Meat, Entrée Salad with Meat, Meat Entrée, Pizza/Calzone, Salad, Sandwiches/Pitas/Flatbreads/Wraps, Soup/Stew/Chili, Tacos/Nachos, and Vegetarian Entrée. A total of 662 food items were included in the final data set.

MyFitnessPal (MFP), an online nutrient and calorie tracker, was used to assign nutritional information to the majority of the food items. Researchers performed a preliminary search using the foodservice provider's name plus the specific food item. For those items that did not have the exact match in MFP, the closest best-fit option was chosen and that nutritional information was assigned to the item. If MFP did not have a close best fit option available, the nutritional information was obtained from the branded vendor's website. Franchises offered through the campus dining provider include examples such as: Java City, Einstein Bros. Bagels, Erbert and Gerbert's Sandwich Shop, etc.

Food items were categorized by study personnel as either "more healthful" (MH) or "less healthful" (LH) according to the American Heart Association (AHA) guidelines. The AHA's "Recommended Nutritional Standards for Procurement of Foods and

Beverages Offered in the Workplace" required all entrées to meet the following calorie, sodium, saturated fat, and trans fat limits per serving, respectively: less than 500 kcal, less than 480 mg, less than 10%, and zero grams.[59]

Analyses

The frequencies were determined for MH and LH entrées purchased and available in the fall 2014 and spring 2015 semesters. Significant differences between purchased and available MH and LH items within each semester were determined using weighted Chi-square test. A weighted Chi-square test was also used to determine whether the proportion of MH and LH entrées purchased between semesters differed.

A logistic regression was used to determine the relationship between students' demographics and MH and LH purchases in the fall 2014 and spring 2015 semesters. An alpha level of 0.05 was used. Independent variables (explained further below) included "completely rural" or "not as rural", EFC, race and ethnicity, and gender.

Odds ratio estimates with 95% confidence limits were used to determine the differences between the various demographics and MH and LH purchases in fall versus spring semesters. All analyses were completed in SAS version 9.4 (2012).

Results

The individual entrée purchases of 12,104 students were analyzed in the fall while the entrée purchases of 11,327 students were analyzed in the spring. Demographics of students are shown in Table 1.

The number of MH and LH entrée items available and purchased in the fall 2014 and spring 2015 semesters are shown in Table 2 below. Of the total 662 entrée items available for purchase, 14.95% (n=99) were considered MH and 85.04% (n=563) were

considered LH. In the fall 8.04% (n=30,010) of purchases were considered MH while 91.95% (n=343,218) purchases were considered LH as compared to 8.87% (n=21,934) and 91.12% (n=225,293) of purchases, respectively in the spring (Figure 1). The actual purchases differed from what was offered in both the fall ($X^2 = 14{,}028.40$, df = 1, $p < 0.0001$) and spring ($X^2 = 7{,}192.13$, df = 1, $p < 0.0001$) semesters.

Students' MH and LH entrée purchases between the fall and spring semesters were statistically significant ($X^2 = 133.98$, df = 1, $p < 0.0001$); the number of LH purchases decreased from 91.95% in the fall to 91.12% (0.83% decrease) in the spring while the number of MH purchases increased from 8.04% in the fall to 8.87% (0.83% increase) in the spring.

The relationship between students' demographics and their MH food purchases are shown in Table 3. It was determined there was no statistical difference between completely rural and not as rural student purchases in the fall; however, in the spring, for each purchase made by someone from a completely rural population, it was 1.19 times more likely to be a MH entrée (OR = 1.19, 95% CI [1.12, 1.27]).

Native Americans compared to Whites did not show significant purchasing differences in the fall, but in the spring, for each purchase made by a Native American, it was 70.0% less likely to be a MH entrée (OR = 0.30, 95% CI [0.135, 0.68]). Purchases made by Asian students were 30.0% less likely to be MH entrées in the fall (OR= 0.70, 95% CI [0.52, 0.96]), but did not show a significant difference in the spring. Purchases made by Hispanic Latinos were 1.34 times more likely to be MH options than those made by Whites in the fall (OR = 1.34, 95% CI [1.12, 1.60]), but Hispanic Latino purchases were approximately 28.0% less likely to choose MH options than purchases made by

Whites in the spring (OR = 0.73, 95% CI [0.55, 0.97]). Purchases made by Multi-Racial students were approximately 48.0% and 47.0% less likely to be MH options than those made by White students in the fall (OR = 0.52, 95% CI [0.43, 0.62]) and spring (OR = 0.53, 95% CI [0.42, 0.66]), respectively. African Americans and Pacific Islanders did not show a significant difference between Whites in either the fall or spring semesters.

Females were 2.23 times more likely in the fall semester (OR = 2.23, 95% CI [2.14, 2.32] and 2.42 times more likely in the spring semester (OR = 2.42, 95% CI [2.31, 2.54] to choose MH options than males. Those with a higher EFC (more affluent families) were less likely to purchase MH items than those who had a lower EFC (less affluent families) in the fall (OR = 0.99, 95% CI [0.99, 0.99]), but did not show significant difference in the spring.

Discussion

Environmental factors influencing college students' dietary behaviors have been identified in the past but few investigators have measured the healthfulness of the environment in relation to students' actual purchases. This study examined the availability of LH foods in the campus dining environment and potential relation to students' purchases of these foods. The lack of MH and overabundance of LH available entrée items suggests the campus dining environment lacks encouragement of healthy dietary behaviors among college students at this university. This finding is consistent with that reported by Tseng and colleagues, of the 314 available entrée items, 88.0% were considered "unhealthful" and the remaining 12.0% were considered "healthful" options as categorized by the Nutrition Environment Measures Survey for campus dining.[60]

Although there were fewer total purchases in the spring semester (potentially explained by the decrease in total students), purchases in the spring were overall healthier than the fall semester. It is also important to note that although students' purchases in the spring were healthier than the fall, the percentage of MH purchases from both semesters was lower than what was available each semester. These results suggest the environment may influence students' purchases and that offering a low percentage of MH entrées may result in even fewer MH purchases.

The impact of the environment on dietary behaviors is supported by the Social Ecological Model (SEM), a program-planning framework suggesting there are different levels of influence (individual, interpersonal, organizational, community, and public policy) on one's dietary behaviors.[61] Each influence is related to the next, and the smallest influences on the person are at the individual level, while the largest influences are at the public policy level. Applying the SEM framework to a college students' food purchases, the campus dining environment falls under the third level (organizational), suggesting the environment strongly impacts a student's purchases. Findings by Greaney address the levels of the SEM influencing college students' dietary behaviors and stated students identified lack of healthy foods served at dining facilities, easy access to unhealthy foods and fast-food restaurants, and expensive healthful options as barriers to eating healthy in the campus dining environment.[50] In short, as stated by Horacek, the college dining environment, does not simply feed college students, but has the potential to be highly impactful in the dietary behaviors of college students.[52]

The findings in this study lay the groundwork for future research interested in determining why young adults, who are at an increased risk for weight gain, are

surrounded by unhealthy foods and how their purchases of these foods impacts their weight over time. It was shown that a large percentage of the foods in the campus dining environment were considered LH and the majority of students' purchases were considered LH. This study was observational and a correlation between what was available and what was purchased was not definitively measured. However, purchases reflect what was offered suggesting in order to make an impact on college students' dietary behaviors, the campus dining environment may be important. Past literature by Hanks and researchers at Cornell University have extensively studied adolescents' healthful food purchases at the high school level and have determined a lunch room that makes healthier options convenient increase purchases of those healthier options.[62] Although a younger age group, these findings may also be applied to the campus dining environment as college students have reported 'a lack of time' as a barrier to healthful food choices.[51] Future research should investigate if the majority of available entrée items are consistently considered LH at other universities consistent at other universities and why students chose healthier options during their second semester of school. Perhaps students return from winter break with "New Year's Resolution's?" Or maybe students are more conscious of their entrée choices in the second semester because they want to lose weight for spring break and/or summer vacation? Future research ought to work with campus dining providers to create profitable, yet healthful, campus dining environments; the relationship between a primarily healthful environment and students' purchases ought to then be measured to determine if an environment consisting of mainly MH foods correlates with an increase in students' purchases of MH items.

Few demographics proved to be statistically significant predictors of healthful purchases in both the first and second semesters, however, this study showed a stark difference between female and male food choices as females were approximately 2.3-2.4 times more likely to choose MH options than males in both semesters. Further research aiming to improve the dietary choices of students at the college level and future effective programming at this age group should target males and be culturally appropriate.

This study stands out in that the healthfulness of entrée purchases (373,228 in the fall semester and 247,227 purchases in the spring semester) from a large population of college students (approximately 11,300 in the fall semester and 12,100 students in the spring semester) was analyzed. Second, because the students' actual food purchases were analyzed, limitations common to that of self-reported food data were avoided. Assuming the purchased foods were eaten, this form of data collection provides an objective representation of typical eating patterns compared to self-reported data for this age group.[56] Lastly, the food purchasing data was collected over a significant period of time (academic school year), versus a shorter period of time at perhaps only the beginning and end of the year.

Although a strong contributor to the literature addressing the healthfulness of students' purchases, this study had a few limitations. First, in order to correlate food purchases with dietary behaviors, it must be assumed the purchased foods were actually consumed. This study did not track students' off-campus purchases or those at the all-you-care-to-eat dining hall; therefore, only the entrée purchases from on-campus à la carte dining facilities were acknowledged. In addition, the reported nutritional information classifying items as MH and LH was highly dependent on three factors: 1)

the foodservice provider's product name, 2) available items in MFP, and 3) the accuracy of the nutritional information in MFP. Also, 88.80% of the students were White, limiting the generalizability to other populations. Lastly, the foodservice provider did not specify which food items were available when, which leads to another limitation: the same foods were assumed to be offered both semesters.

Conclusion

The results of this study further address the healthfulness of the campus dining environment and healthfulness of students' purchases. Students purchases were reflective of what was offered in an environment consisting of primarily less healthful entrée items. Interventions aiming to improve the dietary behaviors of college students should consider targeting the environments and public policies (versus only the individual). Obesity prevention efforts at the college level should also start immediately in the fall when students arrive at school and be gender specific, with an emphasis on improving males' intake.

Table 1. Student Demographics in the Fall and Spring Semesters

	Fall 2014 (Total students = 12,104)	**Spring 2015** (Total students = 11,327)
Demographic	**% (*n*)**	**% (*n*)**
Degree of Ruralness (Total)[1]	**99.31% (12,021)**	**99.24% (11,242)**
Completely Rural[2]	14.90% (1,791)	15.12% (1,669)
Not as Rural[3]	85.10% (10,230)	84.89% (9,543)
Race and Ethnicity (Total)[4]	**100.00% (12,104)**	**100.00% (11,327)**
White	88.80% (10,748)	88.86% (10,065)
Alaskan Native	2.54% (307)	2.71% (3.07)
Native American	1.04% (126)	0.94% (107)
Asian	1.12% (135)	1.05% (119)
Black/African American	2.08% (252)	2.17% (246)
Hispanic/Latino	1.97% (239)	1.88% (213)
Multi-Racial	1.87% (226)	1.77% (200)
Pacific Islander	0.11% (13)	0.11% (12)
Unknown	0.48% (58)	0.51% (58)
Gender (Total)	**100.00% (12,104)**	**100.00% (11,327)**
Female	54.19% (6,559)	54.47% (6,170)
Male	45.81% (5,545)	45.53% (5,157)

[1]Totals differed from Race and Ethnicity and Gender totals as international students could not be assigned an RUC code.
[2]Includes students from counties assigned a Rural-Urban Continuum Code (RUCC) of 8 or 9. RUC code 8 = "completely rural or less than 2,500 urban population and adjacent to a metro area" and RUC code 9 = "completely rural or less than 2,500 urban population and not adjacent to a metro area."
[3]Includes students from counties assigned a RUC code of 1-7. RUC code 1-3 = metro counties and RUC code 4-7 = more than 2,500 urban population.
[4]Race and ethnicity were from the Integrated Postsecondary Education Data System.

Table 2. More and Less Healthful Entrée Items Purchased in the Fall and Spring Semesters

	Fall 2014		Spring 2015	
Entrée Item Healthfulness	**% (*n*)**	**Pr > Chi-Square[3]**	**% (*n*)**	**Pr > Chi-Square[3]**
More Healthful[1]	8.04% (30,010)	<0.0001	8.87% (21,934)	<0.0001
Less Healthful[2]	91.95% (343,218)		91.12% (225,293)	

[1]Defined by the American Heart Association's Recommended Nutritional Standards for Procurement of Foods and Beverages Offered in the Workplace guidelines as entrée items with less than 500 kcal, less than 480 mg sodium, less than 10% saturated fat, and zero grams trans-fat.
[2]Defined as foods that did not meet the American Heart Association's Recommended Nutritional Standards for Procurement of Foods and Beverages Offered in the Workplace guidelines.
[3]Chi-square test for specific portions, significant set at $p > 0.05$. Expected frequency is weighted based on the proportion of more versus less healthful products purchased.

Table 3. Relationship between Students' Demographics and More versus Less Healthful Entrée Purchases in the Fall and Spring Semesters

	Fall 2014	Spring 2015
Demographic	**OR (95% CI)[5]**	**OR (95% CI)**
Degree of Ruralness		
Completely Rural[1] Versus Not as Rural[2]	0.96 (0.91-1.01)	**1.193 (1.12-1.27)**
Race and Ethnicity[3]		
Native American	0.67 (0.42-1.08)	**0.30 (0.14-0.68)**
Asian	**0.70 (0.52-0.96)**	0.910 (0.68-1.22)
Black/African American	0.93 (0.62-1.39)	0.947 (0.515-1.741)
Hispanic/ Latino	**1.34 (1.12-1.60)**	**0.73 (0.55-0.97)**
Multi-Racial	**0.52 (0.43-0.62)**	**0.53 (0.42-0.66)**
Unknown	0.56 (0.28-1.13)	**1.56 (1.11-2.20)**
Gender		
Female Versus Male	**2.23 (2.14-2.32)**	**2.24 (2.31-2.54)**
Family Affluence		
Expected Family Contribution[4]	**0.99 (0.99-0.99)**	0.99 (0.99-1.00)

[1] Includes students from counties assigned a Rural-Urban Continuum Code (RUCC) of 8 and/or 9. RUC code 8 = "completely rural or less than 2,500 urban population and adjacent to a metro area." RUC code 9 = "completely rural or less than 2,500 urban population and not adjacent to a metro area."
[2] Includes students from counties assigned a RUC code of 1-7. RUC code 1-3 = metro counties and RUC code 4-7 = more than 2,500 urban population.
[3] Compared to Whites; no purchases were reported for Alaskan Natives due to missing data; no comparisons were completed with Pacific Islanders due to the low frequency.
[4] Used to determine the financial strength of the student's family.
[5] OR = Odds Ratio and CI = Confidence Interval

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