RELATIONSHIP BETWEEN NUTRITION KNOWLEDGE AND FOOD INTAKE OF COLLEGE STUDENTS

A thesis submitted to the
Kent State University College
of Education, Health, and Human Services
in partial fulfillment of the requirements
for the degree of Master of Nutrition

By
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August 2016
RELATIONSHIP BETWEEN NUTRITION KNOWLEDGE AND FOOD INTAKE OF COLLEGE STUDENTS (122 pp.)

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The purpose of this study was to compare the difference and relationship between nutrition knowledge and food intake among students who had completed a nutrition course and students who had not completed a nutrition course. It was hypothesized that there would be a relationship between the knowledge scores and the Healthy Eating Index (HEI) scores. Also, it was expected that there would be a difference in the nutrition knowledge scores and healthy eating index scores among students who had completed a nutrition course and students who had not completed a nutrition course. The HEI-2010 was used to measure diet quality. The participants (n=121) completed an electronic questionnaire that consisted of 74 nutrition knowledge questions and a 24-hr diet recall form. There was a positive correlation between knowledge scores and HEI scores (P ≤ 0.001). Students who had completed a nutrition course had a mean knowledge score of 49.5 and a mean HEI score of 68.3, while students who had not completed a nutrition course had a mean knowledge score of 39.2 and a mean HEI score of 55.4. This study demonstrated that nutritional knowledge contributes to better food choices and more adequate nutritional intake among college students. Future nutrition interventions to improve dietary quality in college students should focus on improving nutrition knowledge.
ACKNOWLEDGEMENTS

First of all, I am grateful to God for giving me the strength, wisdom, peace of mind and good health to complete this research.

This research would not have been possible without the support of many people. Many thanks to my advisor, Dr. Karen Lowry Gordon who read my numerous revisions and helped make some sense of the confusions I had. Also thanks to my committee members Dr. Natalie Caine-Bish and Ms. Tanya Falcone who offered guidance and support. Thanks to the professors who helped distribute my survey Dr. Eun-Jeong Ha, Dr. David Sharp and Ms. Carmen Blakely-Adams.

And finally, thanks to my parents and siblings who gave me this opportunity to study and provided all the support and love I needed. Thanks to all my friends who endured this long process with me, always offering support and love.
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CHAPTER I
INTRODUCTION

College students gain new experiences, personal freedom and develop a new sense of identity as they transition from adolescence to adulthood and this can pose significant challenges to healthy eating (Cluskey & Grobe, 2009; Franko et al., 2008). Students lives are busy and they often have to balance many different activities and responsibilities. Unfortunately, during this phase, many students engage in unhealthy dietary habits like dieting, meal skipping, and fast food consumption. Minimal physical activity is also common (Franko et al., 2008). Studies have shown that the food choices that students make in college influences their long-term food choices and health behaviors (Kolodinsky, Harvey-Berno, Berlin, Johnson, & Reynolds, 2007). In the spring of 2015 the American College Health Association (ACHA) reported that only 5.4% of the 93,034 college students surveyed ate 5 or more servings of fruits and vegetables daily (ACHA, 2015).

Other studies have also shown that college students are not meeting the recommended intake of fruits, vegetables and dietary fiber (Huang et al., 2003; McCracken, Jiles, & Blanck, 2003) and they overconsume nutrients like fats, sodium and sugar (Anding, Suminski & Boss, 2001; Brevard & Ricketts, 1996; Dinger & Waigandt, 2007; Hendricks, Herbold, & Fung, 2004). These unhealthy eating patterns and habits can be linked to negative future health conditions such as osteoporosis, obesity,
hyperlipidemia, diabetes, cardiovascular disease, hypertension, iron deficiency anemia, and certain cancers (Franko et al., 2008 & U.S. Department of Health and Human Services, 2010).

Nutritional knowledge has been seen to play an important role in promoting healthier eating practices, and as a result lead to the maintenance of appropriate body weight (Kruger et al., 2002). Studies have shown that nutrition knowledge influences food habits which ensures that nutrient needs throughout the life cycle are met (Worsely, 2002). There have been several studies on nutrition education intervention programs (Lee, Lee, & Kim, 2005; Powers, Struempler, Guarino, & Parmer, 2005; Ha & Caine-Bish, 2009; Ha & Caine-Bish, 2011; White, Yong, Tania, & Elizabeth, 2009; You, Sung, & Chang, 2009) that targeted college students with the aim of supporting sound dietary intake. Some of these studies (Ha & Caine-Bish, 2011; Poddar, Hosig, Anderson, Nickols-Richardson, & Duncan, 2010) recorded an increase in knowledge and improved dietary intake post implementation of intervention. Other intervention strategies (Ha & Caine-Bish, 2011; White et al., 2009; You, Sung, & Chang, 2009) that constituted some level of nutrition education showed that increased awareness of nutrition positively affected food choice among college students. By providing nutrition education, it is the intent that knowledge will increase and support sound dietary intake within a specific population or community.

According to Grafova (2006), people who are aware of the connection between poor nutrition and certain health conditions are more likely to follow a balanced diet and avoid excessive weight gain. This means that increasing nutritional knowledge can be a
good strategy to employ in the reduction and control of certain health condition. Kolodinsky, Harvey-Berino, Berlin, Johnson, & Reynolds (2007) found increased knowledge of dietary guidelines to be positively related to healthier eating practices among college students. The authors concluded that healthy eaters have a higher nutritional knowledge leading to good food choices which can promote weight reduction and maintenance of healthy weight. All of these studies suggest that having the knowledge to make the right choices is important in establishing good eating habits at an early age (Huang, Harris, Lee, Nazir, Born, & Kaur, 2003).

There are various tools to evaluate diet quality and the Healthy Eating Index (HEI) is one of the tools that can be used for this analysis (USDA & USDHHS, 2010). The HEI measures diet quality based on how closely the diet adheres to the recommendations set forth by the Dietary Guidelines. The benefit of using this approach (George, Hanss-Nuss, Milani & Freeland-Graves, 2005) is that it evaluates the quality of an individual’s diet rather than just the total amount of calories consumed. The Healthy Eating Index 2010 (HEI-2010) is comprised of 12 components that corresponds to the 2010 Dietary Guidelines. This study used the HEI-2010 to measure diet quality.

**Problem Statement**

Promoting health and reducing chronic disease risk associated with diet and weight of college students is one of the goals of the American College Health Association’s (ACHA) (ACHA, 2007) Healthy Campus 2010 initiatives. Nutrition education and prevention efforts targeted to college students have become an important
public health approach as students face many new dietary challenges and are establishing lifelong health behaviors (Cousineau, Goldstein, & Franko, 2004; Brunth, Rhee, Zhong, 2008; Kolodinsky, Harvey, Johnson, 2007) and the college years is an important time to encourage behavior change through quality nutrition education. While there have been studies (Worsley, 2002; Parmenter & Wardle & Waller 2000; Kolodinsky et al., 2007) on nutritional knowledge impact on food choices and healthy eating, most of these studies were about healthy eating intentions or changes in diet based on the knowledge provided. There are limited studies that has examined the relationship between nutrition knowledge and diet quality in college students. Parmenter and Wardle (2000) indicated that many studies in this area have failed to explore significant associations between nutritional knowledge and dietary behavior. Understanding the association between nutrition knowledge and dietary intake of college students will help in identifying reasons for the development of unhealthy eating habits. This can help inform the development of effective education programs that will promote lifestyle changes and improve healthy eating in college students.

**Purpose Statement**

The purpose of this study is to evaluate the difference and relationship between nutrition knowledge and healthy food intake of undergraduate college students at a North-Eastern Ohio public university.
Hypothesis

1. There will be a relationship between nutrition knowledge and healthy eating index score of college students.

2. There will be a difference in the nutrition knowledge scores between students who have had a previous nutrition class and students who are yet to have a nutrition class.

3. There will be a difference in the HEI (Healthy Eating Index) scores of students who have had a previous nutrition class and students who are yet to have a nutrition class.

Operational Definitions

College Students: Full-time, undergraduate students who are enrolled at Kent State University, Kent campus.

Nutrition Knowledge: Basic knowledge of major nutrients and nutrition, measured using a 74 question true/false questionnaire.

Healthy Eating Index: The Healthy Eating Index (HEI) is a measure of diet quality that assesses conformance to the Dietary Guidelines for Americans (USDA & US DHHS, 2010).

Nutrition class: A basic nutrition course that fulfills Kent State University’s core basic science requirement.
CHAPTER II

REVIEW OF LITERATURE

Nutrition Guidelines

It is essential that all students irrespective of their ages comply with their appropriate nutrition and physical activity-based recommendations in order to enhance their overall health and learning potential. It is also important that college students develop and sustain healthy eating and lifestyle habits during their college years as these habits are likely to be sustained into adulthood and have a vital influence on their health in future (Silliman, Rodas-Fortier & Neyman, 2004).

A new version of the Dietary Guidelines for Americans has been released and it is designed to help Americans choose diets that will meet their nutrient requirements, promote health, support active lives and reduce risk of chronic disease now and in future (U.S. Department of Agriculture (USDA), & U.S. Department of Health and Human Services (USDHHS), 2015). In these guidelines Americans are urged to consume fewer calories, eat a variety of fruits and vegetables, limit intake of sodium, solid fats, refined grains and added sugars, develop healthy eating patterns, maintain a diet low in saturated fats, trans fats, cholesterol and sodium, drink water instead of sugary drinks and be more active. It also emphasizes that everyone has a role in encouraging easy, accessible, and affordable ways to support healthy choices (USDA & USDHHS, 2015).
Recommendations on energy and macronutrients (carbohydrate, fat, and protein) content of college student’s diet should closely reflect the recommendations from the dietary guidelines, but should also be based on the Dietary Reference Intakes (DRI) and the Recommended Dietary Allowance (RDA), according to the appropriate age, gender and life-stage group. Understanding and applying the principles of these health-based guidelines on a day to day basis is essential for achieving a successful result in body weight regulation and disease prevention throughout the lifecycle.

**Nutrient Requirements**

Macronutrients are nutrients needed by the body in relatively large amounts. They include energy yielding nutrient, such as carbohydrates, proteins, lipids and water (Smolin & Grosvenor, 2013). These nutrients are required in relatively large amounts by the body. Liu et al. (2003) found an association between the proportion of energy yielding nutrients and the total energy consumed for weight control. Healthy ranges of intake for energy yielding nutrients have been established as daily recommended intakes.

Carbohydrates serve as a critical and preferred energy source during any form of physical activity and especially during periods of intense, anaerobic activity (Rolfes, Pinna, & Whitney, 2014). Carbohydrate consumption was found to be associated with cognitive processes such as memory and attention in elderly people (Kaplan, Greenwood, Winocur & Wolever, 2000), and this may also beneficial for students striving for academic greatness. The human brain depends exclusively on carbohydrate as an energy source (Lutz, Mazur, & Litch, 2014). The RDA for dietary carbohydrates, which is based on its role as the brain’s primary source of energy, is 130 grams per day for males and
females (Institute of Medicine, 2005). Acceptable energy distribution ranges for carbohydrate for good health is 45 to 65% of daily energy intake (U.S. Department of Agriculture & U.S. Department of Health and Human Services, 2010). Added sugar should be reduced to less than 10% of the total calorie intake (USDA & USDHHS, 2015). It is recommended that adult females consume between 21 to 25 g and males between 30 to 38 g of total dietary fiber daily.

Protein is needed by the body for growth, repair, replacing tissues and fighting infections. As a component of a diet, protein serves to replace amino acids that are broken down to produce energy. The recommended daily intake for protein is five and a half ounce equivalent/day (USDA, USDHHS 2015). Generally, these recommendations can be met through diet alone and without the use of protein or amino-acid supplements (American Dietetic Association, ADA, 2000). Also, it has been established that individuals participating in strength and endurance events have slightly higher protein requirements (1.2-1.7g/kg body weight) due to increased protein losses that occur during training and competition (American College of Sports Medicine, 2000).

Dietary fat is a macronutrient that is also an essential energy source and also helps to absorb nutrients in the body (Huang, Song, Schemmel, & Hoerr, 1994). It has been found to be largely over consumed among college-aged students (Huang, Song, Schemmel, & Hoerr, 1994; Schuette, Song & Hoerr, 1996). It is often the first macronutrient to be limited during periods of caloric restriction due to its high caloric density. Dietary fats are also sources of essential fatty acids that must be obtained through the diet in adequate amounts to prevent nutritional deficiencies and to maintain a
variety of the body’s biological processes (Taylor et al., 2006). To promote good health, the recommendation for total fat and oil intake is set at 27 grams per day about 20 to 35% of total daily energy intake (USDA & USDHHS, 2015). Of this intake, at least 70% should come from unsaturated fatty acids and calories from saturated fat should not exceed 10% of total calories per day (USDA & USDHHS, 2015). Diets with up to 35% of calories from fat can be compatible with good health, if energy intake is reasonable and saturated fat intake is low. However, fats and oils below 20% of calories intake increase the risk of inadequate essential fatty acid intake (Rolfes, Pinna, & Whitney, 2014). Part of the energy allowance of total fat should provide the essential fatty acids (linoleic and linolenic acids). RDA suggests that linoleic acid should provide five to ten percent of daily energy intake and linolenic acids should provide 0.6 to 1.2% of daily energy intake (Rolfes, Pinna, & Whitney, 2014).

Water is an essential nutrient that must be consumed in a diet for survival. Death occurs within only a few days without water (Smolin & Grosvenor, 2013). Water makes up to 60% of human body weight and it is required in large amounts in daily diets. Water serves numerous functions in the body which includes; acting as a lubricant, a transport fluid, and a regulator of body temperature (Smolin & Grosvenor, 2013). Water needs depend on the food eaten, environmental temperature, humidity, as well as an individual’s activity level. This makes a water RDA difficult to establish. According to Rolfes, Pinna, & Whitney (2014), the more energy a person expends, more water is recommended.
Micronutrients are needed by the body in much smaller amounts but still play a vital role in the body. If not available, the body may develop deficiencies. Micronutrients are non-energy yielding nutrients and include vitamins and minerals. Vitamins are required to regulate body processes; minerals are required for bone health and the transport of oxygen. Vitamins are organic molecules that do not provide energy, but are needed to regulate body processes (Smolin & Grosvenor, 2013). Although vitamins do not provide energy, many of them serve as coenzymes for reaction to release energy from carbohydrate, fat, protein and alcohol (Smolin & Grosvenor, 2013). The Adequate Intake (AI) and RDA for intakes of vitamins are made based on age and gender.

Minerals are inorganic molecules that do not provide energy (Hill, Wyse, Anderson, & Anderson, 2004). Minerals form a large class of micronutrients, most of which are considered essential nutrients and they are needed for bone health, transport of oxygen, transmission of impulses and many other functions (Smolin & Grosvenor, 2013). The minerals are divided into two groups: macro-minerals and micro-minerals. RDA for macro- and micro-minerals for good health are according to age and gender. Macro-minerals such as calcium and phosphorous are required in amounts of 100 mg/day or more, whereas micro-minerals such as iron and selenium are required in much smaller amounts, typically less than 15 mg/day (Smolin & Grosvenor, 2013).

**MyPyramid**

MyPyramid was released in April 2005 and it replaced the 1992 Food Guide Pyramid (USDA, 2005). The pyramid symbolizes a personalized approach to healthy eating and physical activity. MyPyramid was adopted by the USDA to provide people
with graphics and symbols that teaches them how to eat and live healthy (USDA, 2005). The symbol of the MyPyramid design is used to illustrate personalization, gradual improvement, physical activity, variety, proportionality and moderation (USDA, 2005). The pyramid uses different colors to represent the five food groups and reemphasize the need for variety. The food groups are grains, vegetables, fruits, milk, and meat and beans. A small silver was given to oils to indicate they can be used but in moderation. Based on a 2,000 kcal diet an individual would need to consume two cups of fruit, two and a half cups of vegetables, six ounces of grains, five and a half ounces of meat and legumes, and three cups of milk every day to maintain a balanced diet (USDA, 2005). MyPyramid is a guide not only to healthier eating but also a healthier lifestyle. The pyramid is three dimensional so it includes a staircase to remind people of the importance of daily physical activity (USDA, 2005).

The MyPyramid used an innovative aspect to make the website (MyPyramid.gov) interactive for the users (USDA, 2005). The plan provides a quick estimate of what and how much food one should eat from the different food groups by entering age, gender and activity level (USDA, 2005). It also has a tracker that provides detailed information on diet quality and in-depth information for every food group including daily recommended amounts (USDA, 2005).

**MyPlate Guidelines**

In 2011, the USDA switched from MyPyramid to MyPlate, a simpler and more user friendly version, in an effort to make it easier for Americans to choose healthy foods. MyPlate helps remind individuals to use the Dietary Guidelines to make smart
food choices, find healthy eating style and build it throughout their lifetime. It divides the plate into 4 different sized sections, with fruits and vegetables providing half of the content of the daily plate and grains and protein making up the remaining half (Nappo, 2011). According to MyPlate guidelines, a plate should be 30% vegetables, 30% grains, 20% fruits and 20% protein, accompanied by a serving (one cup) of dairy (U.S. Department of Agriculture, 2010).

The USDA has established a new website, www.ChooseMyPlate.gov, which contains multiple resources based on the new 2015 Dietary Guidelines for Americans to help individuals meet nutrient and calorie needs and make positive eating choices. The website features the new recommended dietary guidelines. The MyPlate website also gives guides and tips to help people eat more fruits and vegetables.

**Physical Activity-Based Recommendations for College-Aged Students**

In addition to a balanced and varied diet that conforms to the recommendations listed above, college-aged students also need physical activity to adequately balance the energy balance equation. For persons aged 18 to 64 years who are seeking substantial health benefits, it is recommended that they engage in at least 150 minutes of moderately intense activity per week or 75 minutes of vigorous aerobic activity per week (USDA & DHHS, 2015). For those requiring more extensive health benefits, physical activity should be increased to 300 minutes per week (USDA & DHHS, 2015). Furthermore, muscle strengthening activities that involve all of the body’s major muscle groups, such as a total body resistance-training program, are recommended on two or more days of the week (USDA & DHHS, 2015).
Engaging in certain practices such as endurance training may increase one’s sensitivity to insulin (Poehlman, Dvorak, DeNino, Brochu, & Ades, 2000) and allow the body to become more efficient at utilizing stored lipids as energy during higher aerobic thresholds (Brooks & Mercier, 1994). Therefore, diet, physical activity, and genetic influences each have their roles in the way the body processes and utilizes nutrients for energy and must be taken into consideration before prescribing individual recommendations.

**Dietary Intake of College Students**

Several studies have shown college students have a poor nutritional intake. The average college student consumes one serving of fruit, one and a half servings of vegetable, half serving of low-fat dairy and 1.4 servings of whole grains daily. (Strong, Parks, Anderson Winett & Davy 2008; Poddar, Hosig, Nichols, Anderson, & Duncan 2009). Even though several studies have found an increase in the consumption of vegetables and fruits, the amount consumed was still below the recommended amounts of five servings per day (American College Health Association, 2015). College student’s diet have also been found to include little variety, and this may lead to significant vitamin and mineral deficiencies. Several studies show that college students consume high calorie, high-fat food (Zellner et al., 2006) and also an increase in alcohol consumption is evident and this directly contributes to increases in overall caloric intake and is associated with greater consumption of unhealthy food (Strong et al., 2008; Kasparek, Corwin, Valois, Sargent, & Morris, 2008).
Generally, many students fail to meet the national nutritional guidelines and the goals of Healthy People 2020 (Office of Disease Prevention and Health Promotion (ODPHP), 2016). Studies have shown that the nutrient most lacking in the typical college-student’s diet are fiber, vitamin D, vitamin E, calcium, magnesium, potassium, and iron (more common in females) (Strong, Parks, Anderson, Winett & Davy 2008; Poddar, Hosig, Nichols, Anderson, & Duncan 2009; Zellner et al., 2006). Other studies focusing on intake of specific food categories in the college population showed a deficiency in foods like seafood, dairy, fruits, or vegetables (Grimes, 2012). These foods contain most of the nutrients lacking in the college students’ diet. Furthermore, students are also over consuming saturated and trans fats, sodium, and refined sugars through excessive intake of foods that re high in fat, sodium, and/or sugar (Anding, Suminski & Boss, 2001; Brevard & Ricketts, 1996; Dinger & Waigandt, 2007; Hendricks, Herbold, & Fung, 2004). West et al (2006) found that students consumed about 543 ± 671 kcal/day from combined forms of sweetened beverages.

Ingesting a diet (obesity-provoking) that is high in fat and sugar has been shown to produce lack of energy, inability to concentrate, poorer academic performance, feelings of apathy, lack of motivation, low self-confidence, changes in temperament, and disruptions of sleeping patterns; side effects which most students try to avoid (Ernersson, Lindström, Nyström, & Frisman, 2010). Many college students see staying energized, focused and fit as a basis for choosing to stay healthy, but it is also essential that the future consequences of their daily eating habits is another motivating factor to eat healthy. Around age 30 bones stop storing calcium and bone density decreases from that
age and beyond and this leads to early development of osteoporosis and an increased likelihood of fractures (Nordin, Need, Chatterton, Horowitz, & Morris, 1990). Therefore, it is important to build up calcium stores throughout childhood, continuing through teenage and adulthood (Brown, 2011).

A study suggested that coronary atherosclerosis begins at a young age and that lesions indicative of development of atherosclerosis are found in every 1 in 6 teenagers (Tuzcu et al., 2001). However, most college students may not understand how their current diet may have an impact on their future health as they most of them do not experience the ill effects of poor dietary choices at this young age. Therefore, rather than focusing on the future ill effects of today’s poor dietary choices, it may be more effective to understand and address the current motivating factors that affect college students when choosing to eat healthy and the challenges they experience when attempting to do so. This will ensure that appropriate interventions are implemented to promote change in the current dietary intake of many college students.

**Dietary Patterns among College Students**

The distinct environment that encompasses college life has a potential life-long influence on the eating habits of college students. Several studies have shown that the majority of students attending college are not adhering to the nutrient guidelines recommended by the Dietary Guidelines for Americans (Schuettee, Song, Hoerr, 1996; Huang et al., 2003). The typical diet of college students consists of foods that are high in fat and sodium and low in fruits, vegetables, and dairy products (Debate, Topping, & Sargent, 2001). Additionally, findings propose that the diets of college students are also
lacking in fruits and vegetables (Huang et al., 2003), which, along with the other unfavorable eating habits mentioned may affect health status in the future.

Most times the eating patterns of college students are impeded by homework loads, irregular class schedules, part-time jobs and inconsistent sleeping patterns (Brevard & Ricketts, 1996). As a result of this, many college students develop the habit of snacking mindlessly throughout the day to temporarily curb their appetite. Students are also limited to purchasing snack items from vending machines and on-campus convenience stores and sometimes that is the only food source available to them. These overpriced food items are usually high in energy and low in nutritional value, and this may be a contributing factor to the unhealthy diets patterns commonly seen among college students (Brevard & Ricketts, 1996).

Living situation of students have been observed to show differences in nutritional intake. One study suggested that college students living off campus have significantly higher overall intakes of energy and protein compared to students living on campus (Brevard & Ricketts, 1996). This may be due to the idea that students living off campus are more likely to purchase food items from fast food restaurants to meet their dietary needs. Furthermore, one benefit to living on campus is the opportunity to participate in a prepaid meal plan offered by the institution’s cafeteria and food courts. Research investigating the relationship between diet quality and involvement in a prepaid meal plan revealed that students not participating in a meal plan had lower intakes of vegetables, fruit, milk, and meat compared to those with a prepaid meal plan (Brown, Dresen & Eggett, 2005 ), which further supports the concept that students living off
campus may be more likely to replace foods from these essential food groups with nutritionally inferior items offered by fast food restaurants or other easily accessible convenience type-stores.

Change in weight either naturally or intentionally, is frequently observed in students throughout the college years. A common nutritional behavior employed by many students to control or reduce their weight has consisted of restricting calories, mainly in the form of skipping meals, particularly breakfast. However, research shows that individuals who skip breakfast are more likely to have a higher body mass index (BMI) compared to those who eat breakfast (Berkey, Rockett, Gillman, Field & Colditz, 2003). Furthermore, other studies exploring the relationship between BMI and meal pattern behaviors reveal that students with higher BMI’s eat less vegetables – especially green leafy vegetables – and dairy products and more meat products on a daily basis compared to those with a lower BMI (Brunt, Rhee & Zhong, 2008).

Dinger and Waigandt (1997) suggested that the unhealthy eating patterns usually seen among college students should not be overlooked because research has shown that the dietary habits adopted throughout the college years are likely to be adopted and may potentially develop into lifelong behavioral practices, which, if continued, may exert a strong influence on the future health and well-being of individuals.

**Barriers to Healthy Eating**

A variety of factors including time, social class, preferences, cultural practices, media influences, and family structure determine student’s food choices. Also fad diets,
local/organic food movements, fast food advertising flooding the media are saturating popular culture and these have led to different and conflicting cultural messages on what to eat. This combined with money and time leads to a difference in eating habits across society. Food is sometimes also classified as a class issue as the least nutritious food is often the lowest priced foods which leads to structural inequality in society (Wright, Ransom, & Tanaka, 2005). The same can be also said for ready to eat meals that require little or no prep work often time coming out of a can or box, though considered convenient and sometimes cheap are not always healthy. This puts those with monetary and time constraints in a situation where out of ease and necessity they eat unhealthily.

Several studies have also highlighted gender as a factor in the difference in food choices among college students. One study on college students showed that males are less likely to pay attention to food labels and are less interested in their food decisions compared to their female counterpart (Levi, Chan & Pence 2006). Male students are less likely to think about food and eating, while female students view it as a constant thought process. There are many theories that link male’s lack of interest in food decisions to ideologies of masculinity and dieting have often been associated with being feminine. According to Levi, Chan and Pence (2006), since male students are less likely to respond to food knowledge education, other strategies like removing availability of unhealthy food, reducing cost of healthier food and offering samples of healthy food should be employed.

Other barriers that are sometimes related to healthy eating includes long hours spent on campus, commute time to campus, and limited weekly budget for food. A study
found that male students spent more money on campus and consumed more water and alcohol (Jackson, Berry, & Kennedy, 2009). The study also noted that “poor eating behaviors tend to cluster, as individuals who engage in one poor eating behavior generally engage in other poor eating behaviors” like increases in fast food consumption and lower physical activities (Jackson, Berry, & Kennedy, 2009). The study examined the availability of nutritious foods on campus and considered the possibility of changing eating habits by changing lifestyle factors.

**Assessment of Food Available on Campus**

University campus dining environments can either promote or inhibit healthy eating and weight control choices by young adults. For instance, a study showed female students residing in dormitories with on campus dining gained more weight during their freshman year than their counterparts without on campus dining (Kapinos & Yakusheva 2011), and freshmen living on campus gained more weight than students commuting from home (Pliner & Saunders 2008). However, students living on campus ate more fruit, vegetables and dairy products than students living in off-campus apartments (Brunt & Rhee 2008). Students also have a variety of options apart from the dining halls on and off campus from which to choose (union, food courts, snack bars, restaurants, vending and stores). Although grocery stores near college campuses provided a wide array of healthful alternatives, convenience stores on and near campus (Horacek, et al., 2013) students still get food from the campus vending machines (Byrd-Bredbenner, et al., 2012) that provide few healthful foods.
A healthy, quality diet is based on variety, balance, nutrient value, and moderation in the diet (mypyramid.gov). Dietary quality is determined by assessing the food’s nutritive contribution based on an accepted standard whereas dietary consumption usually refers simply to the food’s caloric content (Ziegler, Nelson, Tay, Bruemmer, Drewnowski, 2005). Because dietary consumption is easier to measure using mathematical measures, dietary quality is rarely used in research. However, the U.S. government developed a dietary quality score, the Healthy Eating Index (HEI), which evaluates diets based on ten components: five food groups (fruits, vegetables, grains, milk, meats) and five subgroup intakes of total fat, saturated fat, cholesterol, sodium, and dietary variety. The ten components each has a scoring range, based on individual requirements as assessed by the government-accepted MyPyramid standard of zero to ten, with an overall dietary score of 100 (Kennedy, Ohls, Carlson, & Fleming, 1995). Although the HEI is a good tool when measuring dietary quality, because of the seemingly lacking research in regards to the relationship between HEI score and body composition, further research in that area would be beneficial.

**The Healthy Eating Index-2010**

The U.S. Department of Agriculture (USDA) created the Healthy Eating Index (HEI) to measure the overall quality of individual diets and this may encourage individuals to develop better eating habits. The index measures how well American’s diets conform to the Dietary Guidelines for Americans (DGA) and the original Food Guide Pyramid. There are five major groups (fruits, vegetables, grains, meat and
legumes, and milk) assigned by the USDA (USDA, 2010). For an individual to meet all their nutrient needs, daily recommendations in all food groups were provided. Based on a 2,000 kcal diet, 2 cups of fruit, 2.5 cups of vegetables, 6 ounces of grains, 5.5 ounces of meat and legumes, 3 cups of milk, and 6 teaspoons of oil should be consumed to meet HEI guidelines (Guenther, Reedy, Krebs-Smith, Reeve & Basiotis, 2007).

Prior to HEI-2010, HEI-2005 was scored in studies utilizing data from NDSR (Miller et al., 2011). The HEI-2010 is an updated version of the index that reflects the 2010 Dietary Guidelines (USDA & US DHHS, 2010). The HEI-2010 includes 12 components, 9 of which assess adequacy of the diet, including 1) total fruit; 2) whole fruit; 3) total vegetables; 4) greens and beans; 5) whole grains; 6) dairy; 7) total protein foods; 8) seafood and plant proteins; and 9) fatty acids. The remaining 3, refined grains, sodium, and empty calories (i.e., energy from solid fats, alcohol, and added sugars), assess dietary components that should be consumed in moderation. For all components, higher scores reflect better diet quality because the moderation components are scored such that lower intakes receive higher scores. The scores of the 12 components are summed to yield a total score, which has a maximum value of 100.

The current update of the Healthy Eating Index: HEI-2010 is valid and reliable for use in scoring diet quality based on the 2010 Dietary Guidelines for Americans (Guenther et al., 2013 & 2014). HEI-2010 is in agreement with the position of the Academy of Nutrition and Dietetics, which recommends a Total Diet Approach to healthy eating (Freeland-Graves & Nitzke, 2013). Average scores for US adults are 50-53/100 points (Guenther et al., 2014). Average scores for US children are 47-50/100 (Hiza, Guenther, &
Rihane, 2013). Higher scores indicate lower disease risks and are associated with lower BMIs (Schwingshackl & Hoffmann, 2015). Higher scores also predict better physical performance (Xu et al., 2012).

**Diet Quality Index**

The Diet Quality Index (DQI) is used to measure the quality of dietary consumption based on 10 dietary recommendations as noted in US nutrition guidelines. In research the DQI is often used to measure chronic disease risk in the context of dietary quality. Newby et al employed the Diet Quality Index to evaluate the reliability and reproducibility of the DQI-R (revised version) as used with a Food Frequency Questionnaire (FFQ) (Newby et al., 2003). They (Newby et al., 2003) found that the DQI-R score was directly correlated with biochemical measurements “of carotene (r = 0.43, P < 0.0005), β-carotene (r = 0.35, P < 0.005), lutein (r = 0.31, P < 0.05).” Thus in this study, a DQI was accurate in assessing nutritional intake based on biomarker analysis. To assess all available dietary quality indexes, Kant et al (1996) reviewed all published dietary quality indexes, and especially the DQI and HEI. Patterson, Haines, & Popkin (1994) developed the DQI, which is based on specific nutrient and food intake recommendations from the Food and Nutrition Board, and is successful because it distinguishes high-quality diets based on the evaluative, specific nutrients and a low intake of dietary total and saturated fat. The Healthy Eating Index (HEI) also measures quality based on total and saturated fat intake, cholesterol, sodium, and dietary variety. Thus in Kant’s review, in context of “junk” food consumption or total and saturated fat
intakes, a measure of dietary quality scored by HEI and/or DQI, would be acceptable, valid, and useful. (Kant et al., 1996).

**Assessment of Dietary Intake of College Students**

Dietary intake includes all foods and beverages that are consumed through the mouth with the exclusion of dietary supplements due to lack of information on their composition (Rutishauser, 2005). Assessment is usually by daily food consumption methods (food record and 24-hour recall) and recalled or average food consumption methods (diet history and food frequency questionnaire). Measuring dietary intake is an indirect way of acquiring information on nutrients available and the amount of energy an individual has for metabolism (Rutishauser, 2005). There is always a possibility of errors with any of the methods listed above. Using a more controlled, laboratory-based methods such as food monitoring could be used which requires participants to consume foods that are provided, measured, and recorded. The food remaining would also be measured and recorded after the meal (Rutishauer, 2005).

**24-Hour Dietary Recall**

The 24-hour recall method is considered quick and easy (Lee & Nieman, 1996; Nelson, 2000; Hammond, 2004) and a relatively inexpensive method of data collection regarding food consumption (Lee & Nieman, 1996; Dwyer, 1998). A 24-hour dietary recall is the most commonly used dietary assessment tool that requires the respondents to record all foods and beverages consumed during a given meal or snack within the last 24 hours (Rutishauer, 2005). With a 24-hour recall a subject’s motivation is less of a barrier, and compliance is good (Nelson, 2000); no long term memory is required. It can be used
to estimate nutrient intakes of food groups. The interviewer may also ask questions about who was present during the meal or snack, time of consumption, and duration of meal or snack (Baranowski, 2006). It is an objective method and the respondent does not alter the usual diet (Lee & Nieman, 1996; Dwyer, 1998). The data obtained by a 24-hour recall can be repeated with reasonable accuracy, and good reliability exists between interviewers (Dwyer, 1998).

The 24-hour recall could be conducted over multiple days, like a 3 or 7 days recall. Limitation to this method include inability to recall the kinds and amounts of food eaten, withholding or altering of information by respondents, under reporting of participants, size estimation inaccuracy, lengthy administration and may be complicated for individuals other than registered dietitians. Lack of knowledge of portion size may create problems. The method does not reflect differences in intake for weekend versus weekday, season to season, or shift to shift (Dwyer, 1998). A single 24-hour recall therefore does not represent usual intake, however according to Gibson (2005) repeated 24 hour recalls, repeated on nonconsecutive days and/or seasons could be used to establish usual intake of groups of individuals.

**Food Record or Diary**

A food record involves the participant to record at the time of consumption all food items consumed over a one to seven days’ period of time. Each food item consumed should be broken down into different components and described specifically (Rutishauer, 2005). Other items to be recorded are the amount of each food consumed either weighed or estimated, method of preparation, and the time each item was consumed. Food records
do not depend on memory and can provide important information about respondent’s eating habits (Lee & Nieman, 1996), this includes data on quantity of food, how it is prepared, and timing of meals and snacks (Hammond, 2000). Data from a multiple daily food record would be more representative of usual food intake than single day data (as in the 24-hour recall). Some disadvantages to this method would be portion size estimation problems if meals are not weighed and recall problems occur if foods are not recorded right after consumption (Baranowski, 2006). It also needs a highly motivated responder. It takes more time to obtain the data. Checking and coding records in a standardized way may be difficult.

**Food Frequency Questionnaire**

Another method of assessing dietary intake is the use of a food frequency questionnaire (FFQs). FFQs are printed lists of foods from which individuals are asked to indicate the typical frequency of consumption, and to state in household measurements, the average amounts consumed per day (Nelson 2000). It is also a review of food that is consumed per day or per week or per month (Dwyer, 1998; Hammond, 2004). For ease of evaluation, a FFQ arranges food into groups that have common nutrients (Hammond, 2004). A FFQ can vary in length ranging from very short (e.g. 9 food items for assessing intake of a single nutrient), to very long 35 and complex (e.g. 276 items for a national study of diets and heart diseases) (Nelson, 2000). It assesses energy and nutrient intake by determining how frequently a person consumes limited number of foods that are major sources of nutrients or of a particular dietary component in question. This type of questionnaire lists selected foods from each food group and requires the participant to
report how often each food is consumed over a given period of time, usually the past year (Rutishauer, 2005; Baranowski, 2006, Strong Heart Study Coordinating Center, 2006).

A FFQ provides an overall picture of food intake (Dwyer, 1998; Hammond, 2000), which may be more representative of the usual intake of the individual than the few days of diet record given by the 24-hour record. It can be self-administered and quick to administer (Lee & Nieman, 1996; Dwyer, 1998). The FFQ is inexpensive and can contain up to 200 items per questionnaire. Also, the Food Frequency Questionnaire can collect a large amount of data in a relatively short amount of time in order to assess an individual’s entire diet (Baranowski, 2006).

FFQs do not provide meal pattern data, and require knowledge of portion sizes and literacy skills (Hammond, 2004). If self-administered, the rate of responses may be low and incomplete responses may be given (Dwyer, 1998). According to Lee and Nieman (1996), a FFQ may not represent the usual foods or portion sizes chosen by respondents. Because not all foods can be included in the lists, total consumption is difficult to obtain, and underestimation can occur. Over and under reporting of foods may occur; each FFQ data needs validation (Dwyer, 1998).

**Health Complications Associated with Dietary Habits that Affect College Students**

According to the American Cancer Society (2004), cardiovascular disease, cancer, and stroke are consistently among the top three leading causes of death and they are diet related diseases. The Institute of Medicine (IOM) of the National Academy of Sciences issued a new report suggesting that to save the most lives from chronic disease, policy makers, health care providers and researchers should focus their efforts on helping people
stop smoking; maintain a healthy weight and diet; exercise regularly; and drink alcohol at low to moderate levels (American Cancer Society, 2004). College students are at a developmental period in life that comes with relative independence. These social and developmental freedoms allow emerging adults to explore life possibilities, professional desires, and worldviews. Emerging adulthood is also a time during which many health-related behaviors begin to take form (Larson, Perry, Story, & Neumark-Sztainer, 2006; Betts, Amos, Keim, Peters, & Stewart, 1997). Unfortunately, many of these new behaviors are associated with weight gain, especially among college students (Greaney et al., 2009). Ease and convenience are important factors in food choices among young adults (Larson et al., 2006). Compared to non-students, college students are more likely to view foods in terms of convenience and place less importance on nutrition (Betts et al., 1997).

Majority of college students do not follow the nutrition and physical activity recommendations designed to reduce their risk of having risk chronic disease and they typically consume diets high in fat, sodium, and sugar and low in fruits and vegetables (Anding et al., 2001; Dinger & Waigandt, 1997; Grace, 1997; Hiza & Gerrior, 2002; Tufts Longitudinal Health Study (TLHS), 2000). These poor eating habits occurs as a result of frequent snacking, excess dieting, and consumption of calorie dense but nutrient poor snacks and meals, such as those provided by fast food restaurants (Georgiou et al., 1997). In addition, a study that surveyed college students found that only 35% of students have a regular schedule of physical activity and that a slightly higher proportion of men (40%) than women (32%) regularly exercise (Pinto et al., 1998). Several students in the
previously described focus groups reported spending large amounts of time sitting for class or working on homework, leaving little time for physical activity. Negative experiences using campus recreational resources were also noted. These experiences include overcrowding of the recreational facilities and lines to use the machines, as well as intimidation at the prospect of joining intramural sports teams (Nelson et al., 2008).

College students are at a point in their lives where they are able to change their behaviors. In fact, the students’ social role of learner is largely defined by a readiness to change (National Institute of Health, 1998). Therefore, college campuses serve as a crucial setting where students can overcome perceived barriers to healthy diet and exercise habits, and effective interventions can be implemented (Wallace, Buckworth, Kirby, & Sherman, 2000). Theoretically, the positive changes students make in their college years could persist into adult years.

**Chronic Diseases**

Chronic diseases, including diabetes, cardiovascular disease (CVD) and cancer, are some of the most common causes of deaths in the United States (CDC, 2012). The Centers for Disease Control and Prevention (CDC) reports that seven out of ten deaths in the U.S. are the result of chronic illnesses, and that almost half of all adults in the country have at least one chronic disease (CDC, 2012). About 37% of the U.S. population has CVD, and 11% have diabetes, and it is estimated that about 41% of Americans will develop cancer at some point in their life (USDA 2010). Furthermore, obesity – a major risk factor for many chronic diseases – now affects over a third of adults and one in five
children (CDC 2012). Though chronic diseases are some of the costliest health problems (Agarwal, 2012; CDC 2012), modifiable behaviors such as diet (Agarwal, 2012; Amaral et al., 2010; Hung et al., 2004; CDC 2012; Staser et al., 2011; Van Duyn & Pivonka, 2000) and physical activity habits (Agarwal, 2012; Annesi & Vaughn, 2011; Goncalves & Gomes, 2012; CDC 2012) can prevent, delay, or lessen the severity of many chronic diseases, either directly or indirectly through weight management.

Current U.S. dietary guidelines recommend consuming a variety of plant-based foods for their protective effects, and balancing energy intake and physical activity in order to maintain neutral energy balance and prevent weight gain (USDA & USDHHS, 2010). American Heart Association recommends at least 30 minutes of moderate-intensity physical activity most days of the week, and the U.S. Department of Health and Human Services recommends that school students get 60 minutes per day of exercise (Agarwal, 2012). However, the majority of Americans do not meet these guidelines (USDA & USDHHS, 2010).

“Freshman 15”

The “Freshman 15” refers to the belief that the first year of college is associated with an unavoidable 15-pound weight gain (Lloyd-Richardson, Bailey, Fava & Wing, 2009). Behavioral changes during the freshman year leave open the possibility that students may passively increase their energy intake and/or decrease their physical activity, resulting in the “Freshman 15” term (Hoffman, Policastro, Quick, & Lee, 2006).
A study carried out on first-year college students, found that more than 90% were aware of the “Freshman 15” (Jung, Bray & Ginis, 2008).

Research suggests that excess weight gain during the freshman year is due to an increase in calories due to poor dietary choices and a decline in physical activity (Hoffman et al., 2006). Dietary and activity patterns of many college students predispose them to future health problems and weight gain and patterns of unhealthy behaviors during this transitional year from high school may contribute to overweight and obesity in adulthood (Hoffman et al., 2006). In terms of energy balance, behavioral changes during the freshman year leave open the possibility that students may passively increase their energy intake and/or decrease their physical activity, giving rise to the “Freshman 15” (Hoffman et al., 2003).

Although many studies have found that there is a significant increase in weight amongst adolescents from high school to the end of their first year of college, the mean weight increase has been less than 15 making the “Freshman 15” more a myth than reality. This belief may be as a result of certain choices college students make that includes overeating in buffet-style cafeterias, participating in nonphysical activities during free time, increased alcohol consumption, and making poor choices of what foods, where, and how much to eat (Hoffman et al., 2003). This does not, however, weaken the belief that the college environment promotes changes in many aspects of a student’s life in which physical activity and dietary behaviors in the majority of American college students who do not meet recommended levels contribute to unhealthy weight gain and future health problems.
Obesity Trends in College Students

Obesity rates have dramatically increased over the past fifty years in the United States, and this is an important public health concern (Ogden, Carroll, Curtin, McDowell, Tabak, & Flegal, 2006). Current data from the Centers for Disease Control and Prevention show that the percent of adolescents ages 12-19 years who are obese is 18.4% and the percent of adults age 20 years and over who are obese is 35.9%. The National College Health Risk Behavior Survey estimated that as many as 35% of college students are overweight or obese (Huang et al., 2004). Diet and physical activity have been emphasized as the main factors affecting weight. The cause of obesity has been known to be excess energy (calories) consumed over energy expended in daily activities (Nestle, 2003). Because of this astonishing high number health care providers are educating people on the fact that obesity is directly related to a number of health conditions, such as type 2 diabetes, heart disease and hypertension.

Currently, college students have a reputation of having poor dietary habits and low activity levels. Strong et al (2008) in their study found that healthful eating and obtaining adequate physical activity were not considered high priorities among college students. A national survey performed by the American College Health Association in 2015 found that many college students are not meeting the recommended intake of fruits and vegetables. College students have also been reported to gain weight more rapidly than the general population (Strong et al., 2008). Factors that may affect student’s ability to practice diet and physical activity behaviors that promote weight loss include self-efficacy and absence of depression. It has been found that eating and exercise self-
efficacy is strongly associated with weight loss behaviors (Linde, Rothman, Baldwin, & Jeffery, 2006). Increased prevalence of mood and anxiety disorders has been reported among individuals who are overweight or obese (Barry, Pietrzak, & Petry, 2008). Recognizing demographic behavioral, and psychological factors that impact weight in college students could be important in the development of targeted weight loss interventions.

**Eating Disorder in College Students**

According to the newly updated Diagnostic and Statistical Manual of Mental Disorders (DSM-5), there are several types of specific eating disorders and they include Anorexia Nervosa (AN), Bulimia Nervosa (BN), Binge Eating Disorder (BED), Eating Disorder Not Otherwise Specified (EDNOS) and several feeding disorders like pica, rumination and avoidant/restrictive food intake disorder (these were previously characterized in DSM-IV as "Disorders Usually First Diagnosed in Infancy, Childhood, or Adolescence") (American Psychiatric Association, 2013).

The various forms of eating disorders affect all races, ages, genders, and societal classes. Nevertheless, women are more commonly affected than men as 0.5% to 3.7% of women have AN while 1.1% to 4.2% of women deal with BN (Depalma, Koszewski, Barile, Delpama & Oliario, 1993). Caucasian young adults often appear to be more concerned about body weight and have more negative body cognitions than any other ethnic group (Sira & Pawlak, 2010). Young Caucasian women in particular have been
found to exhibit disordered eating patterns than women of other ethnicities (Sira & Pawlak, 2010).

Peer groups is another factor that can have an influence on college students’ eating attitudes and behaviors. Within the college community there are subgroups of students sometimes at greater risk of developing or continuing eating-related problems, such as those in sororities or in collegiate athletics. Those in sororities report greater use of diet pills, elimination of high fat foods and weight concerns interfering with social relationships (Hoerr, Bokram, Lugo, Bivins & Keast, 2002). According to Yager and O’dea (2008) women living in sorority houses have a greater fear of becoming fat, greater body dissatisfaction and weight preoccupation, as well as higher concern with dieting.

Both male and female college athletes feel an immense pressure to perform at high levels. In certain sports, a specific weight class or body shape is linked to this high performance. This leads college athletes to become more obsessed with weight and weight control. Among men, the frequency of eating disorder risks tends to be the highest in those who participated in inter-collegiate athletics and the relation of suicidal thoughts to risk for eating disorder was highest for the female athletes (Hoerr et al., 2002).

The media has been seen to be a great influence on the college age group. There is the constant portraying of thinness which can play into a student’s desire to want to fit in and be accepted. This pressure plays a decisive role in triggering negative self-evaluation, weight control, unhealthy eating behavior, and the development of eating disorders.
among college females (Sira & Pawlak, 2010; Le Grange, Telch, & Tibbs, 1998). The media portrays certain foods as bad leading to the fear of eating certain types of food which can be a precursor for a disordered eating pattern, and may lead to a decrease in highly needed nutrients (Hoerr et al., 2002).

**Health Consequences of Eating Disorder Behavior**

Apart from the high risk of death from untreated, chronic ED, other physical and psychological side effects can occur. Some of the physical consequences may include: malnutrition, dehydration, severe organ damage (heart, kidney, and/or liver), tooth or gum erosion, esophageal tears and ruptured stomach (Vohs, Heatherton & Herrin, 2001). Malnutrition presents differently for each ED category. While those with AN eat very little and receive little to no nutrients, those with BN or EDNOS do obtain some level of nutrition. Daily intake varies and thus their nutrition status is unclear.

Moreover, few data exist regarding the average nutritional status for ED individuals, in addition to differences in nutritional status among ED classifications. The psychological consequences of ED may include: depression, low self-esteem, shame or guilt, impaired relationships, mood swings, perfectionism, and extremist thinking (Vohs et al., 2001). Such serious, and sometimes fatal, health consequences warrant persistent efforts to detect those at risk for developing an ED with subsequent attempts at ED prevention in high-risk populations.
Importance of Nutrition Knowledge to College Students

Nutrition knowledge is the “knowledge of health and nutrition” (Worsely, 2002). Nutrition knowledge is an important factor that influences healthy food habits which ensure that nutrient needs throughout lifecycle are met (Worsely, 2002). According to Worsely, the ability of an individual to meet their nutritional needs will enable them make healthy food choices that enhances health and wellness by preventing excess intake of nutrients that could be associated with ill health (Worsely, 2002).

Kruger et al. (2002) suggests nutritional knowledge as an important factor in promoting healthier eating habits, and consequently, maintaining an appropriate body weight, thus, preventing overweight and obesity. People who are aware of the connection between poor nutrition and certain health conditions are more likely to follow a balanced diet and avoid excessive weight gain (Grafova, 2006).

Individuals with basic nutrition knowledge have been found to apply what they have learnt or are aware of when selecting food (Read & Schlenker, 1993). Several studies have shown that individuals fail to make nutrition a priority when selecting food because they are poorly informed about dietary guidelines (Frederick & Hawkins, 1992; Lissner & Heitmann, 1995; Mitchell, 1990). Therefore, improving nutrition knowledge through education and interventions may help prevent chronic disease and improve standard of life (Read & Schlenker, 1993).

To secure society health, there is a need for people to understand how to utilize a healthy diet for greater benefits to their health. Therefore, nutrition education in a
community focus on food behavior patterns by increasing knowledge on food value so as to improve dietary practices and consequently to enhance nutrition status of an individual (FAO, 2010) ecology and sustainability (Worsley, 2002).

**Effects of Nutrition Knowledge on Food Choices**

Worsley (2002) conducted a literature review of studies on the correlation of nutrition knowledge and eating behaviors and found that "many studies show no relationship, but there are some that do, albeit many at 'low' levels of evidence". A conceptual model was used by Mirsa (2007) to determine the association between knowledge, attitudes and nutrition label use among 537 randomly selected undergraduates from two Midwestern universities using a mail questionnaire. There was an indication that “nutritional education, age, sex and attitude predicted label use". The study also showed that although the majority of students perceived food labels to be useful and easy to read, there was an inherent distrust of the truthfulness and accuracy of food labels (Mirsa, 2007).

Other studies, however, showed that knowledge does, in fact, influence eating habits. A study (Parmenter et al., 2000) assessed and surveyed the participants and determined accordingly the link between knowledge and application. After careful analysis, the authors saw the correlation between knowledge and healthy eating habits. The participants with more nutrition knowledge were twenty-five percent more likely to consume sufficient amounts of fruits and vegetables daily.
In 2002, Worsley conducted a study on an adult population in the US that revealed a direct correlation between cancer-prevention knowledge and adequate consumption of healthy foods. The more knowledgeable adults consumed vegetables, fruits, fiber, and fat in amounts closer to the recommended daily values than the less knowledgeable participants. A study conducted by the USDA’s economic Research Service revealed that the mothers’ knowledge about food and nutrition directly affected their children’s diets (Blaylock, Variam, & Lin, 1999).

A cross sectional study by Kolodinsky et al (2007) examined the relationship between current dietary guidelines and food choice by college students in the dining hall and found that for fruit, dairy, protein, and whole grains, increased knowledge was associated to better eating behaviors. The study also indicated nutrition knowledge as the main determinant of individual food choices in every case (Kolodinsky et al., 2007). It appears that when posed with a question about a specific type of food, students are able to use their knowledge to make a more healthful choice. (Kolodinsky et al., 2007). The results of this study suggests that overall better eaters have higher nutrition knowledge.

**Nutrition Interventions for College Students**

Nutrition education programs have been designed to improve nutrition knowledge, with the aim of supporting sound dietary intake within a specific group of people (Lee et al, 2005; Powers, Struempler, Guarino, & Parmer, 2005; Morgan et al., 2010; Heaney, O’Connor, Michael, Gifford & Naughton, 2011). The government, schools and other health promotion agencies have helped spread nutrition information by delivering messages that includes a nutrition component (Worsley, 2002).
Several nutrition intervention strategies that target college students have been implemented. One study (Ha & Caine-Bish, 2011) used an interactive, introductory nutrition course focusing on disease and recorded an increase in knowledge and intake of whole grains consumption. Another study (Poddar et al., 2010) used a web-based intervention using an online course system (email messages, posted information, and behavior checklists with tailored feedback) and recorded an increased self-regulation and self-efficacy in consuming three servings/day of dairy products.

Other intervention strategies have been implemented, most of which incorporate some level of nutrition education (Ha & Caine-Bish, 2009; White et al., 2009; You et al., 2009). By providing nutrition education, it is the intent that knowledge will increase and support sound dietary intake within a community or specific population. An intervention conducted at three public schools in Chicago, Illinois consisted of monthly sessions of nutrition education over the course of a school year, and the results were promising. Researchers were able to determine that by providing nutrition education students experienced significant improvements in regards to nutrition knowledge. Improvements were also seen in behavior and intentions, but even more promising is that these improvements were translated into reductions in BMI and waist circumference (Monty, Handu, & Chmel, 2008). Another study (Peterson, Duncan, Null, Roth, and Gill, 2010) that was done to determine the effects of a point of selection intervention on college students’ perceptions and selections of targeted health foods in a campus dining hall, had results that showed that increased awareness of nutrition positively affects food choice among college students.
CHAPTER III

METHODS

The purpose of this study was to evaluate the difference and relationship between nutrition knowledge and food intake of college students. It was hypothesized that:

1. There would be a relationship between nutrition knowledge and healthy food intake of college students.
2. There would be a difference in the nutrition knowledge scores between students who have had a previous nutrition class and students who are yet to have a nutrition class.
3. There would be a difference in the HEI (Healthy Eating Index) scores of students who have had a previous nutrition class and students who are yet to have a nutrition class.

Research Design

This was a non-experimental, cross-sectional study designed to evaluate the difference and relationship between nutritional knowledge and food intake in college students. For the assessment of difference, the independent variable was the completion of a nutrition course and the dependent variables were the nutrition knowledge and HEI scores.
Sampling

Participants for this study were undergraduate students enrolled in the NUTR 23511 Science of Human Nutrition class during the Fall 2015 (students who have completed a nutrition course) and Spring 2016 (students who have not completed a nutrition course) semesters at Kent State University. The NUTR 23511 course covers basic concepts and principles in the science of human nutrition, energy balance and weight control, individual nutrient needs, diet selection, nutrition related metabolism and physiological functions, nutritional diseases and current human nutrition controversies. The data were collected at the end of the fall semester and before the spring semester to get a proper distinction between the two groups of students. The reason for using students enrolled in the NUTR 23511 class was because this course provided a distribution across freshmen, sophomores, juniors and seniors as it is a fulfillment of Kent State University’s core basic science requirement and most non science students take it to make up their science credit hours’ requirement. Respondents were recruited using emails sent from the professors that taught the class to the students that enrolled in the class. Students who agreed to participate in the study were required to sign an electronic Informed Consent Form (Appendix A) before proceeding to complete the questionnaire. Graduate and part-time students were excluded from the study.

Questionnaire

An online questionnaire (Appendix B) was developed using the Qualtrics software to collect participant’s responses. The questionnaire was prepared based on a
previous research paper conducted by Hoogenboom, Morris, Morris & Schaefer (2009) with some modifications made so that its suitable for this study.

**Questionnaire Components**

The questionnaire consisted of three parts: demographic information, nutrition knowledge and 24-hour diet recall and it was used to collect data and variables.

**Demographic section.** The first section of the questionnaire included participants’ demographics and characteristics. It consisted of the following items: age, gender, educational level and living conditions. It also included questions about the student’s eating situation (if they bought and prepared their own food or if they had their food prepared by someone else) and their eating habits (if they were omnivorous, semi-vegetarian, lacto-ovo-vegetarian or vegan).

**Nutrition knowledge.** This section consisted of a series of 74 nutrition statements that may or may not be correct. Participants indicated their responses to the statements by selecting “True”, “False” or “Do Not Know”.

**24-hr diet recall.** The third section of the questionnaire was the 24-hour diet recall which was used to evaluate food intake of college students. Participants were required to recall and record all foods they had eaten within a 24-hour period. They were asked to described in detail the food item and include the quantity/portion they ate.
Scoring Questionnaire

For the nutrition knowledge section of the questionnaire scores were calculated by summing the number of correct responses. Statements answered correctly were given a score of one, and statements answered incorrectly, including those with the answer “Do Not Know” were scored as zero. The overall score was referred to as the knowledge score. Higher scores indicated a better knowledge of nutritional information.

The list of foods from the 24-hr recall was entered into the Food Processor Nutrition Analysis Software. This gave a numeric value for nutrient components and also it calculated total values of food group’s components. The diet quality was then evaluated using the Healthy Eating Index (HEI)-2010 tool (Center for Nutrition Policy and Promotion (CNPP), U.S. Department of Agriculture, 2010).

Diet Quality

The student’s diet was evaluated for quality using the HEI-2010 tool. The components required to calculate the HEI scores were taken from the results of the diet analysis. To calculate the HEI score each of the index components were measured and it was ensured that these measures conformed to the units of measures included in the index (CNPP & USDA, 2010). The procedure for calculating each component of HEI-2010 was derived from the Nutrition Data System for Research Guide to Creating Variables Needed to Calculate Scores for each Component of the Healthy Eating Index-2010 developed by the Nutrition Coordinating Center (NCC), University of Minnesota, Minneapolis, MN. The Healthy Eating Index-2010 total dietary quality scores compare
diet quality to the 2010 Dietary Guidelines for Americans. Each student’s diet quality score was calculated using dietary recall data by summing 12 dietary component scores (Appendix C): nine assessing meeting adequate intake and three assessing moderation. Higher dietary quality scores indicated higher dietary quality (Appendix D)

### Procedures

Approval for this study was received from the Institutional Review Board (IRB) of Kent State University. Participants were recruited for this study electronically. Two different groups of students were recruited for the survey: students enrolled in a nutrition class for fall 2015 and students enrolled for spring 2016. Students enrolled for fall 2015 were classified as students who have had a nutrition class and students who enrolled for spring 2016 semester were classified as students who have not had a nutrition class. The Nutrition 23511 class had ten sections in the fall of 2015 and eight sections in the spring of 2016 and students voluntarily agreed to participate in the study. The professors that taught NUTR 23511 were contacted by the researcher via e-mail and they were asked to distribute the recruitment email to their students. All of the professors agreed to do so.

An initial email (Appendix E) describing the purpose and background of the study, along with a hyperlink to a web-based questionnaire administered through the online survey software Qualtrics was sent to all professors on December 12, 2015. The professors were asked to forward the email to their students. The participants were provided with a web based consent form that explained their right to participate in the study with the option to accept or decline participation. The questionnaire included
instructions on how to complete the survey and how to properly enter the diet recall. A reminder email was sent on January 7, 2016 and this was the same exact email that was initially sent.

**Data Analysis**

Descriptive statistics were used to describe frequencies of age, gender, semester (fall 2015 - students who had taken a nutrition course and spring 2016 - students who had not taken a nutrition course), educational level (freshman, sophomore, junior and senior), eating situation (if they bought and prepared their own food vs if they had their food prepared by someone else) and eating habits (omnivorous, semi-vegetarian, lacto-ovo-vegetarian or vegan). Using SPSS software (v 22.0), Pearson correlation was used to evaluate the relationship between nutrition knowledge scores and healthy eating index scores. A one-way analysis of variance (ANOVA) with P value set at 0.05 for significance was used to compare knowledge scores and HEI scores between the two groups of students.
CHAPTER IV

JOURNAL ARTICLE

Introduction

College students gain new experiences, personal freedom and develop a new sense of identity as they transition from adolescence to adulthood and this can pose significant challenges to healthy eating (Cluskey & Grobe, 2009; Franko et al., 2008). They have busy lives and often must balance many different activities and responsibilities. Unfortunately, during this phase, many students engage in unhealthy dietary habits like dieting, meal skipping, and fast food consumption. Minimal physical activity is also common (Franko et al., 2008). Studies have shown that the food choices that students make in college influences their long-term food choices and health behaviors (Kolodinsky, Harvey-Berno, Berlin, Johnson, & Reynolds, 2007). In the spring of 2015 the American College Health Association (ACHA) reported that only 5.4% of 93,034 college students surveyed ate five or more servings of fruits and vegetables daily (ACHA, 2015). These unhealthy eating patterns can be linked to negative future health conditions like osteoporosis, obesity, diabetes, cardiovascular disease, hypertension, and certain cancers (Franko et al., & U.S. Department of Health and Human Services, 2010).

A study that was done in the United Kingdom showed a positive association between nutritional knowledge and eating habits (Wardle, Parmenter, & Waller, 2000). There have been several studies on nutrition education intervention programs (Lee et al,
that targeted college students with the aim of supporting sound dietary intake. Some of these studies (Ha & Caine-Bish, 2011; Poddar, Hosig, Anderson, Nickols-Richardson, & Duncan, 2010) recorded an increase in knowledge and improved dietary intake post implementation of intervention. The Healthy Eating Index (HEI) is one of the tools that can be used to measure diet quality (USDA & USDHHS, 2010). The HEI measures diet quality based on how closely the diet adheres to the recommendations set forth by the Dietary Guidelines. The Healthy Eating Index 2010 (HEI-2010) is comprised of 12 components that corresponds to the 2010 Dietary Guidelines. This study used the HEI-2010 to measure diet quality.

Promoting health and reducing chronic disease risk associated with diet and weight of college students is one of the goals of the American College Health Association’s (ACHA) (ACHA, 2007) Healthy Campus 2010 initiatives. Nutrition education and prevention efforts targeted to college students have become an important public health approach as students face many new dietary challenges and are establishing lifelong health behaviors (Cousineau, Goldstein, Franko, 2004; Brunth, Rhee, Zhong, 2008; Kolodinsky, Harvey, Johnson, 2007) and the college years is an important time to encourage behavior change through quality nutrition education. While there have been studies (Worsley, 2002; Parmenter & Wardle & Waller 2000; Kolodinsky et al., 2007) on nutritional knowledge impact on food choices and healthy eating, most of these studies were about healthy eating intentions or changes in diet based on the knowledge provided.
There are limited studies that has examined the relationship between nutrition knowledge and diet quality in college students. Parmenter and Wardle (2000) indicated that many studies in this area have failed to explore significant associations between nutritional knowledge and dietary behavior. Understanding the association between nutrition knowledge and dietary intake of college students will help in identifying reasons for the development of unhealthy eating habits. This can help inform the development of effective education programs that will promote lifestyle changes and improve healthy eating in college students.

The purpose of this study was evaluate the difference and relationship between nutrition knowledge and healthy food intake of undergraduate college students at a North-Eastern Ohio public university. In this study, the research hypotheses were (1) that there would be a relationship between nutrition knowledge and HEI scores of college students, (2) that there would be a difference in the nutrition knowledge scores between students who have had a previous nutrition class and students who are yet to have a nutrition class and (3) that there would be a difference in the HEI scores of students who have had a previous nutrition class and students who are yet to have a nutrition class.

**Methodology**

This was a non-experimental, cross-sectional study designed to evaluate the difference and relationship between nutritional knowledge and food intake in college students. For the assessment of difference, the independent variable was the completion
of a nutrition course and the dependent variables were the nutrition knowledge and HEI scores.

**Sampling**

Participants for this study were undergraduate students enrolled in the NUTR 23511 Science of Human Nutrition class during the fall 2015 (students who have completed a nutrition course) and spring 2016 (students who have not completed a nutrition course) semesters at Kent State University. The NUTR 23511 course covers basic concepts and principles in the science of human nutrition, energy balance and weight control, individual nutrient needs, diet selection, nutrition related metabolism and physiological functions, nutritional diseases and current human nutrition controversies.

The data were collected at the end of the fall semester and before the spring semester to get a proper distinction between the two groups of students. The reason for using students enrolled in the NUTR 23511 class was because this course provided a distribution across freshmen, sophomores, juniors and seniors as it is a fulfillment of Kent State University’s core basic science requirement and most non science students take it to make up their science credit hours’ requirement. Respondents were recruited using emails sent from the professors that taught the class to the students that enrolled in the class. Students who agreed to participate in the study were required to sign an electronic Informed Consent Form (Appendix A) before proceeding to complete the questionnaire. Graduate and part-time students were excluded from the study.
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An online questionnaire (Appendix B) was developed using the Qualtrics software to collect participant’s responses. The questionnaire was prepared based on a previous research paper conducted by Hoogenboom, Morris, Morris & Schaefer (2009) with some modifications made so that its suitable for this study.

**Questionnaire components.** The questionnaire consisted of three parts: demographic information, nutrition knowledge and 24-hour diet recall and it was used to collect data and variables.

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**Nutrition knowledge.** This section consisted of a series of 74 nutrition statements that may or may not be correct. Participants indicated their responses to the statements by selecting “True”, “False” or “Do Not Know”.

**24-_hr diet recall.** The third section of the questionnaire was the 24-hour diet recall which was used to evaluate food intake of college students. Participants were required to recall and record all foods they had eaten within a 24-hour period. They were asked to described in detail the food item and include the quantity/portion they ate.
**Scoring Questionnaire**

For the nutrition knowledge section of the questionnaire scores were calculated by summing the number of correct responses. Statements answered correctly were given a score of one, and statements answered incorrectly, including those with the answer “Do Not Know” were scored as zero. The overall score was referred to as the knowledge score. Higher scores indicated a better knowledge of nutritional information.

The list of foods from the 24-hr recall was entered into the Food Processor Nutrition Analysis Software. This gave a numeric value for nutrient components and also it calculated total values of food group’s components. The diet quality was then evaluated using the Healthy Eating Index (HEI)-2010 tool (Center for Nutrition Policy and Promotion (CNPP), U.S. Department of Agriculture, 2010).

**Diet Quality**

The student’s diet was evaluated for quality using the HEI-2010 tool. The components required to calculate the HEI scores were taken from the results of the diet analysis. To calculate the HEI score each of the index components were measured and it was ensured that these measures conformed to the units of measures included in the index (CNPP & USDA, 2010). The procedure for calculating each component of HEI-2010 was derived from the Nutrition Data System for Research Guide to Creating Variables Needed to Calculate Scores for each Component of the Healthy Eating Index-2010 developed by the Nutrition Coordinating Center (NCC), University of Minnesota, Minneapolis, MN. The Healthy Eating Index-2010 total dietary quality scores compare
diet quality to the 2010 Dietary Guidelines for Americans. Each student’s diet quality score was calculated using dietary recall data by summing 12 dietary component scores (Appendix C): nine assessing meeting adequate intake and three assessing moderation. Higher dietary quality scores indicated higher dietary quality (Appendix D).

**Procedures**

Approval for this study was received from the Institutional Review Board (IRB) of Kent State University. Participants were recruited for this study electronically. Two different groups of students were recruited for the survey: students enrolled in a nutrition class for fall 2015 and students enrolled for spring 2016. Students enrolled for fall 2015 were classified as students who have had a nutrition class and students who enrolled for spring 2016 semester were classified as students who have not had a nutrition class. The Nutrition 23511 class had ten sections in the fall of 2015 and eight sections in the spring of 2016 and students voluntarily agreed to participate in the study. The professors that taught NUTR 23511 were contacted by the researcher via e-mail and they were asked to distribute the recruitment email to their students. All of the professors agreed to do so.

An initial email (Appendix E) describing the purpose and background of the study, along with a hyperlink to a web-based questionnaire administered through the online survey software-Qualtrics was sent to all professors on December 12, 2015. The professors were asked to forward the email to their students. The participants were provided with a web based consent form that explained their right to participate in the study with the option to accept or decline participation. The questionnaire included
instructions on how to complete the survey and how to properly enter the diet recall. A reminder email was sent on January 7, 2016 and this was the same exact email that was initially sent.

**Data Analysis**

Descriptive statistics were used to describe frequencies of age, gender, semester (fall 2015 - students who had taken a nutrition course and spring 2016 - students who had not taken a nutrition course), educational level (freshman, sophomore, junior and senior), eating situation (if they bought and prepared their own food vs if they had their food prepared by someone else) and eating habits (omnivorous, semi-vegetarian, lacto-ovo-vegetarian or vegan). Using SPSS software (v 22.0), Pearson correlation was used to evaluate the relationship between nutrition knowledge scores and healthy eating index scores. A one-way analysis of variance (ANOVA) with P value set at 0.05 for significance was used to compare knowledge scores and HEI scores between the two groups of students.

**Results**

The study was conducted among students at Kent State University, aged 18-34 years old. Survey was sent out to approximately 1734 students who enrolled for the NUTR 23511 class in the fall 2015 and spring 2016 semesters. A total of 163 students consented to participate in the study. Of that total, 121 students completed the survey (7% response rate) and their responses were analyzed and used in the study. Participants who
indicated their academic level as part-time and who did not complete the 24-hr diet recall were excluded.

The study compared two groups of students. The first group were students who had completed a nutrition course with 53 students completing the survey. The second group consisted of students who had not completed a nutrition course with 68 students completing the survey. Participants’ characteristics and demographics are displayed in Table 1.

On analyzing the eating situation of college students, 58 (47.9 %) students answered yes to the question: I buy and/or prepare my own food thus I generally control what I eat and 63 (52.1%) students said their food was normally prepared by someone else. On the eating habits, 84.3% (102) of students said they were omnivorous, 6.6% (8) were semi-vegetarian, 2.5% (3) were lacto-vegetarian, 4.1% (5) were lacto-ovo-vegetarian, 1.7% (2) vegan and one person said they avoid red meats and don’t drink milk.

**Correlation of HEI Scores and Knowledge Scores**

A Pearson’s product moment correlation coefficient was computed to assess the relationship between the knowledge scores and the HEI scores of the participants. It was hypothesized that there would be a relationship between the knowledge scores and HEI scores. The correlation analysis showed a positive correlation \( r = .346, n=121, P \leq 0.001 \) between the two variables. A scatter plot (Figure 1) summarizes the results. Overall, there was an increase in HEI scores when knowledge scores increased.
### Table 1.

**Demographic Data of College Age Adults That Completed a Nutrition Knowledge Questionnaire (n=121)**

<table>
<thead>
<tr>
<th>Demographics</th>
<th>Completed Nutrition Course % (n=53)</th>
<th>Not Completed Nutrition Course % (n=68)</th>
<th>Total % (n=121)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Age (years)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>18-25</td>
<td>98.1(52)</td>
<td>98.5(67)</td>
<td>98.3(119)</td>
</tr>
<tr>
<td>26-34</td>
<td>1.9(1)</td>
<td>1.5(1)</td>
<td>1.7(2)</td>
</tr>
<tr>
<td><strong>Gender</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>7.5(4)</td>
<td>13.2(9)</td>
<td>10.7 (13)</td>
</tr>
<tr>
<td>Female</td>
<td>86.8(46)</td>
<td>86.8(59)</td>
<td>86.8 (105)</td>
</tr>
<tr>
<td>No response</td>
<td>5.7(3)</td>
<td>0(0)</td>
<td>2.5 (3)</td>
</tr>
<tr>
<td><strong>Educational Level</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Freshman</td>
<td>24.5(13)</td>
<td>45.6(31)</td>
<td>36.4 (44)</td>
</tr>
<tr>
<td>Sophomore</td>
<td>47.2(25))</td>
<td>36.8(25)</td>
<td>41.3 (50)</td>
</tr>
<tr>
<td>Junior</td>
<td>24.5(13)</td>
<td>13.2(9)</td>
<td>18.2 (22)</td>
</tr>
<tr>
<td>Senior</td>
<td>3.8(2)</td>
<td>4.4(3)</td>
<td>4.1 (5)</td>
</tr>
<tr>
<td><strong>Living Situation</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>On-Campus</td>
<td>60.4(32)</td>
<td>64.7(44)</td>
<td>62.8 (76)</td>
</tr>
<tr>
<td>Off-Campus</td>
<td>39.6(21)</td>
<td>35.3(24)</td>
<td>37.2 (45)</td>
</tr>
</tbody>
</table>
Figure 1: A Pearson Correlation showing the Relationship between the Knowledge Scores and HEI scores of College Aged Adults that Completed a Nutrition Knowledge Questionnaire ($r = .346, n= 121, P \leq 0.001$).

HEI Scores and Nutrition Course Status

HEI Scores of participants was assessed based on “completed” versus not “completed” a nutrition course. It was hypothesized that there would be a difference in the HEI scores between the groups. Utilizing a one-way between subjects’ ANOVA it was determined that there was a significant difference in the HEI scores of students who
had completed a nutrition course versus students who have not completed a nutrition course (P ≤ .001) (Table 2).

**Knowledge Scores and Nutrition Course Status**

Knowledge scores of participants was assessed based on “completed” versus “not completed” a nutrition course. It was hypothesized that there would be a difference in the knowledge scores between the groups. Utilizing a one-way between subjects’ ANOVA, it was determined that there was a significant difference in the knowledge scores among students who had completed a nutrition course and students who had not completed a nutrition course (P ≤ .001) (Table 2).

**Table 2.**

*Total Knowledge and Healthy Eating Index (HEI) Score means (\(\bar{x} \pm SD\)) of students who have had a nutrition class and students who have not had a nutrition class.*

<table>
<thead>
<tr>
<th></th>
<th>Completed Nutrition Course (n=53)</th>
<th>Not Completed Nutrition Course (n=68)</th>
<th><em>P-Value</em></th>
</tr>
</thead>
<tbody>
<tr>
<td>Knowledge Score (^a)</td>
<td>49.5 ± 8.9</td>
<td>39.2 ± 10.1</td>
<td>0.001</td>
</tr>
<tr>
<td>HEI Score (^b)</td>
<td>68.3 ± 18.2</td>
<td>55.4 ± 19.8</td>
<td>0.001</td>
</tr>
</tbody>
</table>

\(^a\) Shows statistical significant difference between students who have had a nutrition class and students who have not had a nutrition class where statistical significance was set at P ≤ 0.05
\(^b\) Knowledge calculated by summing the number of correct responses on a 74 “True”, “False” or “Do Not Know” nutrition knowledge questionnaire: higher scores indicated more knowledge; score reported as total out of maximum 74 points possible

\(^b\) HEI scores calculated by using the HEI-2010 tool; higher scores indicated better diet quality- maximum score of 100
Knowledge Scores and HEI Score versus Eating Habits and Situations

Utilizing a one-way between subjects’ ANOVA, knowledge and HEI scores were assessed based on the eating habits (i.e. whether they are Omnivorous, Semi-Vegetarian, Lacto-ovo-vegetarian, Vegan, Other) and eating situation (i.e. whether they buy and/or prepare most of their own food or if food is normally prepared by someone else) indicated by the students. It was determined that there was no significant difference in the knowledge scores ($P = .968$) and HEI scores ($P = .725$) of students with different eating habits. While there was no significant difference in the HEI scores of students based on eating situations ($P = .085$), there was a significant difference in the knowledge scores based on the eating situation of college students, with students that indicated that they bought and prepared their own food doing significantly better on the nutrition knowledge questionnaire ($P \leq .001$).

Discussion

This section presents the discussion of the study findings on nutrition knowledge and its association with the diet quality of college students that have completed and not completed a nutrition course.

Nutrition Knowledge

The research hypothesis stated that there would be a difference in the nutrition knowledge between students who had completed a nutrition course and students who had not completed a nutrition course. The findings in this study accepted the hypothesis as it showed a significant difference in the knowledge of nutrition between the two groups of
students. This finding is consistent with other studies that have shown students are slightly aware of nutrition issues (Barzegari, Ebrahimi, Azizi, & Ranjbar, 2011; Sakamaki et al, 2005). The difference in the knowledge score between these two groups of students can be attributed to the fact that the students who had completed a nutrition course had an exposure to basic concepts and principles in the science of human nutrition unlike the students who have not completed a nutrition course. Studies that used intervention embedded within college course were effective at improving nutrition and diet related outcomes (Werch et al., 2008; Ha & Caine-Bish, 2011, Hekler, Gardner & Robinson, 2010). The better performance by students who had completed a nutrition course could be as a result of the fact that the course covered basic concepts and principles of human nutrition and it involved frequent face-to-face contact with highly educated instructors and also students received feedback on their progress. This is consistent with findings in a study that suggested that frequent professional contact may help improve health outcome by enhancing vigilance and providing encouragement and support (Elfhag & Rossner, 2005).

Nutrition knowledge is one of the key factors in the prevention of risk factors associated with the early onset of chronic disease. It enhances healthy food choices and optimal dietary practices to help lessen the burden of early onset on chronic diseases. Diet plays an important role throughout lifecycle in promoting good health and preventing lifestyle diseases which have been significantly linked to poor dietary habits. Today, students have access to a wide source of nutrition information. However, the school environment continues to be an avenue through which majority of students can
gain access to the right kind of information that will broaden their knowledge and this may impact their future health. These results agree with a previous study that showed the school environment as the last and important avenue through which majority of students can be impacted with nutritional knowledge and this spirals up improvement in society’s health (Berzegari et al, 2011).

**Diet Quality**

The research hypothesis stated that there would be a difference in the HEI scores between students who had completed a nutrition course and students who had not completed a nutrition course. The findings in this study indicated a significant difference in the HEI scores between the two groups of students. Regular eating practices and healthy food choices ensure that college students meet their nutritional requirements for growth and health maintenance. The HEI-2010 tool was used to measure diet quality in this study. It has an ideal/optimal score of 100, with scores greater than 80 considered good, scores 51 - 80 considered fair and scores below 51 considered poor. Higher scores indicate lower disease risks and has been seen to be associated with lower Body Mass Index (Schwingshackl & Hoffmann, 2015). Students that participated in this study had an HEI scores that fell under the “fair” category. Even though students that had a nutrition class had a better diet quality than student who have not had a nutrition class they still did not fall under the “good” grade for diet quality. The low HEI scores in students who have had a nutrition class indicates that even though students have knowledge they are still not meeting their recommended diet intakes. Results in this study agree with previous studies.
that show that college students are not adhering to the nutrient guidelines advocated by the Dietary Guidelines for Americans (Schuettee, Song, Hoerr, 1996; Huang, 2003).

Student’s poor nutritional intake could be attributed to factors like irregular meal patterns affordability and availability of meals on college campuses (Yahia, Achkar, Abdallah, & Rizk, 2008). In this study student’s diet choice reflected those high in sugar, refined grains and empty calories. Their diet was generally low in fruits and vegetables, greens and beans, seafood and plant proteins. This agrees with a previous study that showed high consumptions of high calorie food among college students (Schuettee et al., 2003). Though almost every student in this study got the maximum total protein score, their scores on seafood and plants proteins were very low. This could be due to its palatability, convenience, ease of availability and affordability. As people are increasingly eating away from home, fast food restaurants are becoming an important source of meals for college students. Students preference for fast food eateries could be attributed to their preference for cheap, easy and convenient eating places due to time demand on their academic workload (Horacek et al., 2013). Students diet quality can be limited by others factors such as; socio economic, gender difference, peer pressure and environmental factors (Levi, Chan & Pence 2006). Student’s finance is another factor that is likely to limit adequate purchase of foods therefore predisposing them to skipping some meals (Prah, 2010).


**Relationship between Nutrition Knowledge and Healthy Eating**

The correlation between nutrition knowledge and diet quality of students was significant in this study. Students who have had a nutrition class had higher knowledge scores and HEI scores than students who had not completed a nutrition course. The significant findings of this study are in accordance with other studies which have demonstrated a relationship between nutrition knowledge and food intake (Beydoun, Powell & Wang, 2009; Dallongeville et al., 2001; Pieniak, Verbeke & Scholderer, 2010; Wardle, Parmeter & Waller, 2000). Hence this study accepted the hypothesis that there would be a relationship between nutrition knowledge and HEI scores. This relationship between knowledge and diet quality could be attributed to the fact the students who have completed a nutrition course had a better understanding of basic nutrition principles than students who have not completed a nutrition course.

Individuals with basic nutrition knowledge have been found to apply what they have learnt or are aware of when selecting food (Read & Schlenker, 1993). This was evident during the analyses of the 24-hr diet recall of the present study, students who had completed a nutrition course showed better recall ability, in that they were able to record their diet in detail, including proper sizes and measurements. Students who had not completed a nutrition course were not as detailed in their 24-hr diet recall records. This observed practice gap could be attributed to inadequate knowledge/ lack of awareness on the importance of meals distribution and portion size throughout the day.
Nutrition education strategies help to raise levels of knowledge aiming at preventing unhealthy food related lifestyles as well as promoting society’s health. The results of this study showed that nutrition knowledge was significantly related to dietary habits and nutrients intake. This corresponds with a study that sampled Korean students (You et al., 2009) and indicated significant reductions in body weight, body fat mass, percentage of body fat, waist-hip ratio, and body mass index. Several intervention studies that used nutrition education strategies showed an improvement in dietary habits of college students post intervention (Ha & Caine-Bish, 2011; You et al., 2009; Ha & Caine-Bish, 2009). Other studies have also reported changes in dietary habits after interventions involving educational lectures as a nutrition improvement tool. For instance, Ha and Caine-Bish (2009) have successfully showed an increased consumption of fruits and vegetables after nutrition interventions.

Nutrition knowledge indirectly contributes to nutrition status when good dietary practices are translated into practice and sustained in life. College students being in their active stage of life may not realize the need for nutrition knowledge to guide their eating habits and to maintain health such as normal weight so as to prevent lifestyle diseases of latter stages of life and that is why it is important to introduce nutrition knowledge to them at this stage. Knowledge targets to influence dietary practices by promoting actions that lead to healthy food intake and in discouraging negative practices likely to negatively influence nutrition status. This could be attributed to the fact that knowledge influences lifestyle behavior which takes a process to completely change into practices that directly
influence nutrition status. Healthy food choices contribute towards healthy management of body weight and in prevention of nutrient deficits that are likely to lead to poor health.

Limitations

This study had several limitations. Firstly, the sample size was relatively small. With the overall enrollment in the NUTR 23511 class being approximately 1734 and the total number of student on campus of about 20,000 in the fall of 2015 and spring of 2016, the response of 121 students cannot predict the results of the entire university. The study was also limited by the use of a convenience sample. There were no incentives given for the completion of the survey. Data was also collected between semesters (over the Christmas break) and this may have contributed to the low response as student do not typically check their school emails at this time.

Strengths

This study used the HEI-2010 tool to evaluate diet quality which is a valid and reliable measure of diet quality according to the 2010 dietary guidelines for Americans. This tool can be used in research to better-understand relationships between nutrients, foods, and/or dietary patterns and health-related outcomes.

Applications

Nutrition knowledge becomes important when it influences healthy choices and practices. As indicated in this study higher knowledge through course based nutrition education indicated higher diet quality. The NUTR 23511 course that was used in this
study was a 16-week compulsory course that covered nutrition science and principles, energy balance, weight control and individuals’ nutrient needs. Student’s access to face-to-face contact with highly educated instructors and receiving feedback on their progress may have influenced their nutrition behavior and eating habits. Based on the results of this research there is need to enhance nutrition education programs among college students. Colleges are an ideal setting for the implementation of nutrition educational programs as they often comprise of a large population of students who are at an important stage for the development of lifestyle skills and behaviors. Students have access to world-class facilities, technology and educated staff including a variety of health disciplines all of which can be used in the development of effective nutrition intervention programs promoting health. Universities curriculum should include common undergraduate nutrition courses for all students particularly disciplines where nutrition and health is not directly or indirectly taught.

This study indicated that students are not fully aware of the importance and functions of food groups. This was evident in their diet intake that showed that their diet was lacking in essential macronutrient and micronutrients. As these negative dietary habits could worsen during university years, any undesirable dietary norm should be addressed at earlier ages and preferably through individuals’ routine learning environments (Ha & Caine-Bish 2009). Data collected in this study is useful in recommending nutrition interventions that are tailored and easily accessible to college students. Hence, introducing nutrition course as part of the curriculum is a well-suited technique to improve both students’ dietary habits and their awareness of overall health.
Nutrition education and prevention efforts targeted to college students have become an important public health approach to help promote health and reduce chronic disease risk associated with diet and weight of college students and it is one of the goals of the American College Health Association’s (ACHA) (ACHA, 2007) Healthy Campus 2010 initiatives. Students face many new dietary challenges in college and are establishing lifelong health behaviors (Cousineau, Goldstein, Franko, 2004; Brunth, Rhee, Zhong, 2008; Kolodinsky, Harvey, Johnson, 2007) and this is an important time to encourage behavior change through quality nutrition education. With the restraints of time and money that some nutrition programs might involve, utilization of a nutrition course in schools is a cost effective way of utilizing resources available on campus to share nutrition information and promote health programs in the with the college age population.

However, knowledge alone does not necessarily translate to practice as indicated in this study. This study showed that overall students did not have a good diet quality. This indicates that while knowledge is a good way of influencing healthy choices, other interventions strategies could be included. This can be done by enhancing enabling environment where students can access and exploit sources beyond the conventional classroom set up through organizing food fairs, through the dinning services, office of global education, clubs, organizations and societies available on campus to enable students benefit from a wide range of authenticated nutritional information. Dining halls within the university should be guided by nutrition principles to ensure provision of convenient, nutritious, varied, acceptable and affordable meals for students to discourage reliance on unhealthy convenient fast foods that expose students to future health risks that
are preventable. Peer based support strategy should be encouraged and even formalized within universities as young adults do not seem to realize the long term benefits of healthy dietary practices compared to long term effects of unhealthy food choices (White et al., 2009). Peer support provides potential for strong linkages and motivation within students’ networks. Students who had completed a nutrition course exhibited higher knowledge than students who had not completed a nutrition course and they may help disseminate and influence positive nutrition habits within peer networks. (White et al., 2009).

Further studies should be conducted on student’s strategic nutrients intake and factors influencing their dietary practices be investigated since they exhibited some form of nutrition knowledge and a fair diet quality but non optimal dietary practices.

**Conclusion**

The purpose of this study was to obtain new insights on the effectiveness of nutrition education course on the knowledge and dietary intake of college students. Students who took a nutrition course performed better on the nutrition knowledge questions and had a better diet quality. These findings reinforced findings from other studies that showed improvement in dietary intake after a nutrition education intervention. In college, students are still at an age where their health behaviors can be impacted so colleges should present a learning environment were nutrition information focused on young adults with the aim of improving dietary behaviors are taught. Results from this study can be used to suggest the inclusion of nutrition courses and programs to
university curriculum. Also, results can be used to recommend the creation of university
policies that includes health promotion programs in campus residences and dining
facilities to promote healthy food choices. Research evaluating the effectiveness of
nutrition education modules in changing student dietary behaviors needs to be further
explored.
APPENDIX A

CONSENT FORM
APPENDIX A

Consent Form

Informed Consent to Participate in a Research Study

Study Title: Relationship between Nutrition Knowledge and Healthy Eating of College students

Principal Investigator: Mercy Nani

You are being invited to participate in a research study. This consent form will provide you with information on the research project, what you will need to do, and the associated risks and benefits of the research. Your participation is voluntary. Please read this form carefully. It is important that you ask questions and fully understand the research in order to make an informed decision. You will receive a copy of this document to take with you.

The purpose of this study is to determine the relationship between nutrition knowledge and healthy food intake of undergraduate college students at a North Eastern Ohio Public University.

In order to participate in this study, it is required to be enrolled in Kent State University as an undergraduate student. Participation in this study typically takes 15-25 minutes and is strictly anonymous. Participants will be required to fill a 3-part nutrition questionnaire. The data being collected will include demographic information, nutrition knowledge questions followed by a 24-hr diet recall form. The participants only have to fill out the initial questionnaires and there are no follow-up requirements.

There are no anticipated risks beyond those encountered in everyday life.

All responses are treated as confidential, and in no case will responses from individual participants be identified. Rather, all data will be pooled and published in aggregate form only. Participants should be aware. However, that the experiment is not being run from a “secure” https server of the kind typically used to handle credit card transactions, so there is a small possibility that responses could be viewed by unauthorized third parties (e.g., computer hackers).

Taking part in this research study is entirely up to you. You may choose not to participate or you may discontinue your participation at any time without penalty or loss of benefits to which you are otherwise entitled. You will be informed of any new, relevant
information that may affect your health, welfare, or willingness to continue your study participation.

If you have any questions or concerns about this research, you may contact Mercy Nani or Dr. Karen Lowry Gordon RD, LD at 330.672.2248. This project has been approved by the Kent State University Institutional Review Board. If you have any questions about your rights as a research participant or complaints about the research, you may call the IRB at 330.672.2704.

If you are 18 years of age or older, understand the statements above, and freely consent to participate in the study, click on the "I Agree" button to begin the experiment.

I Agree  I Do Not Agree
APPENDIX B

Nutrition Survey

Please answer questions in each section to the best of your knowledge. Try to be as truthful as possible as there are no penalties for wrong answers.

Part I: Consent Form

Part II Demographic Questions

1 How old are you?
   ○ 18-25 (1)
   ○ 26-34 (2)
   ○ 35-54 (3)
   ○ 55-64 (4)
   ○ 65 or Older (5)

2 What is your gender?
   ○ Male (1)
   ○ Female (2)

3 When did you enroll for the NUTR 23511 Science of human nutrition class?
   ○ Fall 2015 (1)
   ○ Spring 2016 (2)

4 What is your current educational level?
   ○ Freshman (Registered for a minimum of 12 credit hours) (1)
   ○ Sophomore (30-59 Credit hours earned) (2)
   ○ Junior (60-89 credit hours earned) (3)
   ○ Senior (90 credit hours earned - graduation) (4)
   ○ 5th year senior (120 credit hours earned - graduation) (5)

5 Part time or Full Time?
   ○ Part time (1)
   ○ Full Time (2)
6 Which best describes your eating situation? Please select one.
- I buy and/or prepare most of my own food; thus I generally control what I eat (1)
- My food is normally prepared by a family member, roommate, food service of a dorm, sorority house, student union, etc.; thus I am somewhat limited in my food selection. (2)

7 What category best describes your eating habits? Please select one.
- Ominivorous (consumes all types of food) (1)
- Semi-vegetarian (avoid all red meat but consume poultry and fish) (2)
- Lacto-vegetarian (avoid all flesh food and eggs but consume dairy products) (3)
- Ovo-vegetarian (avoid all flesh food and eggs but consume dairy) (4)
- Lacto-ovo-vegetarian (avoid all flesh food but consume dairy products and eggs) (5)
- Vegan (avoid all animal products) (6)
- Other (Please Specify) (7) ____________________

8 Where do you live?
- On-campus (1)
- Off-campus (2)

Part 2: Nutrition Survey

For each question, select True/False or Don’t Know. Please try to give answers to the best of your knowledge without looking it up. For questions you don’t know the answer to select "Do Not Know"

1 An equivalent weight of carbohydrates and protein have approximately the same caloric value.
- True (1)
- False (2)
- Do Not Know (3)

2 Carbohydrates are not as easily and rapidly digested as protein and fat.
- True (1)
- False (2)
- Do Not Know (3)
3 A slice of bread is an example of 1 serving from the bread and cereals food group.
- True (1)
- False (2)
- Do Not Know (3)

4 Honey contains fewer calories than an equal amount of sugar.
- True (1)
- False (2)
- Do Not Know (3)

5 Foods such as potatoes and honey are best eaten after exercise.
- True (1)
- False (2)
- Do Not Know (3)

6 Eggs and legumes are examples of protein sources other than meat.
- True (1)
- False (2)
- Do Not Know (3)

7 Protein is the primary source of muscular energy.
- True (1)
- False (2)
- Do Not Know (3)

8 Protein is not stored in the body; therefore, it needs to be consumed every day.
- True (1)
- False (2)
- Do Not Know (3)

9 All red meat is high in saturated fat.
- True (1)
- False (2)
- Do Not Know (3)
10 No more than 15% of calories in the diet should be obtained from fat.
- True (1)
- False (2)
- Do Not Know (3)

11 Substitution of polyunsaturated fat for some saturated fat is recommended to lower the risk of heart disease.
- True (1)
- False (2)
- Do Not Know (3)

12 Adequate fat intake is necessary for estrogen production.
- True (1)
- False (2)
- Do Not Know (3)

13 Broccoli is a plant source of calcium.
- True (1)
- False (2)
- Do Not Know (3)

14 Milk is a good supplier of calcium for all age groups.
- True (1)
- False (2)
- Do Not Know (3)

15 800 milligrams of calcium per day is the Recommended Dietary Allowance (RDA) for females age 15-24.
- True (1)
- False (2)
- Do Not Know (3)
16 Adequate calcium intake is necessary for female athletes of all ages to prevent osteoporosis.
- True (1)
- False (2)
- Do Not Know (3)

17 Two 8 ounce glasses of milk is enough to fulfill the recommended amount of calcium per day.
- True (1)
- False (2)
- Do Not Know (3)

18 Carbonated beverages can negatively affect calcium metabolism.
- True (1)
- False (2)
- Do Not Know (3)

19 Iron deficiency anemia results in a decrease in the amount of oxygen that can be carried in the blood.
- True (1)
- False (2)
- Do Not Know (3)

20 Cheese is a good source of iron in the diet.
- True (1)
- False (2)
- Do Not Know (3)

21 Those with a meatless diet are at a higher risk for iron deficiency.
- True (1)
- False (2)
- Do Not Know (3)
22 Iron in meat is absorbed at the same rate as iron in a plant food.
   - True (1)
   - False (2)
   - Do Not Know (3)

23 Due to menstruation, females need more iron in their diets than men.
   - True (1)
   - False (2)
   - Do Not Know (3)

24 A lack of iron in the diet can result in fatigue, injury, and illness.
   - True (1)
   - False (2)
   - Do Not Know (3)

25 Meat and eggs are good sources of zinc.
   - True (1)
   - False (2)
   - Do Not Know (3)

26 Bananas and avocados are good sources of potassium.
   - True (1)
   - False (2)
   - Do Not Know (3)

27 Vitamin supplementation is recommended for all physically active people.
   - True (1)
   - False (2)
   - Do Not Know (3)
28 Excess vitamin supplementation may harm the physically active person.
- True (1)
- False (2)
- Do Not Know (3)

29 Vitamins in mineral enriched foods are not used by the body as well as naturally occurring vitamins.
- True (1)
- False (2)
- Do Not Know (3)

30 Vitamins are a good source of energy.
- True (1)
- False (2)
- Do Not Know (3)

31 Green, leafy, and yellow vegetables are important because they help ensure the Vitamin A requirement for the individual.
- True (1)
- False (2)
- Do Not Know (3)

32 Carrots are a good source of vitamin A.
- True (1)
- False (2)
- Do Not Know (3)

33 Whole milk is a better source of vitamin D than skim or 2% milk.
- True (1)
- False (2)
- Do Not Know (3)
34 The body can synthesize vitamin D with exposure to the sun.
   - True (1)
   - False (2)
   - Do Not Know (3)

35 Potatoes, strawberries, and cantaloupe are good sources of vitamin C.
   - True (1)
   - False (2)
   - Do Not Know (3)

36 The best sources of folic acid are supplemented grain products and fortified breakfast cereals.
   - True (1)
   - False (2)
   - Do Not Know (3)

37 Vitamin E is required for blood clotting.
   - True (1)
   - False (2)
   - Do Not Know (3)

38 Salt is an essential part of a healthy diet.
   - True (1)
   - False (2)
   - Do Not Know (3)

39 Fiber in the diet may help to decrease constipation, decrease blood cholesterol levels, and prevent cancers.
   - True (1)
   - False (2)
   - Do Not Know (3)
40 Bread and cereals is the only food group that is a good source of fiber.
○ True (1)
○ False (2)
○ Do Not Know (3)

41 Two servings of vegetables per day fulfills recommended dietary allowances.
○ True (1)
○ False (2)
○ Do Not Know (3)

42 Dark colored vegetables have more nutritional value than pale vegetables.
○ True (1)
○ Neither True nor False (2)
○ False (3)

43 Fresh, frozen, and canned vegetables all have similar nutrient values.
○ True (1)
○ False (2)
○ Do Not Know (3)

44 Nutrients can be destroyed if vegetables are overcooked.
○ True (1)
○ False (2)
○ Do Not Know (3)

45 Eating oatmeal may decrease your risk of heart disease.
○ True (1)
○ False (2)
○ Do Not Know (3)
46 Carotenoids work to prevent the formation of free radicals.
☐ True (1)
☐ False (2)
☐ Do Not Know (3)

47 Natural and organic foods are more nutritious than foods grown under conventional methods.
☐ True (1)
☐ False (2)
☐ Do Not Know (3)

48 Dehydration can impair physical performance.
☐ True (1)
☐ False (2)
☐ Do Not Know (3)

49 During activity, thirst is an adequate guide to the need for fluids.
☐ True (1)
☐ False (2)
☐ Do Not Know (3)

50 During exercise, mass ingestion of large amounts of fluid is preferred over frequent ingestion of small amounts.
☐ True (1)
☐ False (2)
☐ Do Not Know (3)

51 An athlete should drink no water during practice, but rather rinse out his/her mouth or suck on ice cubes.
☐ True (1)
☐ False (2)
☐ Do Not Know (3)
52 Sports drinks are the best way to replace body fluids lost during exercise.

- True (1)
- False (2)
- Do Not Know (3)

53 Alcohol consumption can affect absorption and utilization of nutrients.

- True (1)
- False (2)
- Do Not Know (3)

54 Alcohol has more calories per gram than protein.

- True (1)
- False (2)
- Do Not Know (3)

55 Caffeine has been shown to improve endurance performance.

- True (1)
- False (2)
- Do Not Know (3)

56 Caffeine can increase the risk of dehydration.

- True (1)
- False (2)
- Do Not Know (3)

57 An athlete involved in endurance events (e.g. distance running) should follow a considerably different diet than one participating in events of short duration (e.g. sprinting).

- True (1)
- False (2)
- Do Not Know (3)
58 A physically fit person eating a nutritionally adequate diet can improve her performance by consuming greater amounts of nutrients.

- True (1)
- False (2)
- Do Not Know (3)

59 A muscular person expends more energy at rest than a non-muscular person of the same age, sex, and weight.

- True (1)
- False (2)
- Do Not Know (3)

60 A 200-pound person uses about twice as many calories to run a mile as a 100-pound person.

- True (1)
- False (2)
- Do Not Know (3)

61 A person with a higher percentage of body fat may weigh less than a person of the same size with a greater muscle mass.

- True (1)
- False (2)
- Do Not Know (3)

62 A sound nutritional practice for college students is to eat a wide variety of different food types from day to day.

- True (1)
- False (2)
- Do Not Know (3)
63 Skipping meals is justifiable if you need to lose weight quickly.
- True (1)
- False (2)
- DO Not Know (3)

64 When trying to lose weight, acidic foods such as grapefruit are of special value because they burn fat.
- True (1)
- False (2)
- Do Not Know (3)

65 If trying to lose weight, carbohydrates should come only from fruits and vegetables rather than from breads and pastas.
- True (1)
- False (2)
- Do Not Know (3)

66 The relationship of good eating habits to good health should be stressed to college students.
- True (1)
- False (2)
- Do Not Know (3)

67 The type of food a college student eats affects his/her physical performance.
- True (1)
- False (2)
- Do Not Know (3)

68 What the student eats is only important if the student is attempting to gain or lose weight.
- True (1)
- False (2)
- Do Not Know (3)
69 Nutrition is more important during the competitive season than during the off-season for the athlete.

☐ True (1)
☐ False (2)
☐ Do Not Know (3)

70 Food advertisements are a very reliable source of nutritional information.

☐ True (1)
☐ False (2)
☐ Do Not Know (3)

71 The college student should schedule his/her physical activities so they have adequate time to eat.

☐ True (1)
☐ False (2)
☐ Do Not Know (3)

72 Learning about nutrition is not important for college students because they eat so much food they always get the nutrients their bodies need.

☐ True (1)
☐ False (2)
☐ Do Not Know (3)

73 Learning facts about nutrition is the best way to achieve favorable changes in food habits.

☐ True (1)
☐ False (2)
☐ DO Not Know (3)
74 Nutritional counseling would be important to the college student who is trying to change his/her weight.

- True (1)
- False (2)
- DO Not Know (3)

**Part III**

Please write down all food and beverages you have eaten in the past 24 hours. Include portion size and time of day. Feel free to include additional information that best describes your food. Under the meal section enter "B" for Breakfast, "L" for Lunch, "D" for Dinner and "S" for Snack

**Instructions**

- Think back to everything you ate yesterday starting with the first thing you ate when you woke up. Be sure to record the approximate time you ate each item.
- Be specific. Is your bread white, wheat, or whole grain? Is your milk whole, 2%, 1% or skim?
- Be detailed about preparation. Was the food baked, grilled, fried, steamed? Or was it fresh, frozen, or canned?
- Include portion size of the food item you ate. Try to quantify by using cups, ounces, teaspoons, or tablespoons.
- Include all ingredients in the items you are eating. Do not just write a salad or a sandwich. List all of the toppings with approximate amounts.
- Include fluids that you drink. List the amount and type of beverage you are drinking. Don’t forget to include the water you drink throughout the day.
- Don’t forget the condiments. Make sure to account for cream in coffee, ketchup on French fries, sour cream on a baked potato, dressing on salad, etc.
24 Hour Diet Recall Form

Please write down all food and beverage you have eaten in the past 24 hours. Include portion size and time of day. Feel free to add additional information that best describes your food.

<table>
<thead>
<tr>
<th>Time</th>
<th>Meal</th>
<th>Food Item and Detail</th>
<th>Portion Size</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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</tr>
</tbody>
</table>

Good Example of 24-Hour Diet recall

<table>
<thead>
<tr>
<th>Meal</th>
<th>Time</th>
<th>Food Item and Detail</th>
<th>Portion Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>Breakfast</td>
<td>8:00 am</td>
<td>Whole Eggs Scrambled</td>
<td>2 eggs</td>
</tr>
<tr>
<td></td>
<td></td>
<td>With olive oil</td>
<td>1 tablespoon</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Sugardale Bacon</td>
<td>2 pieces</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Whole grain toast</td>
<td>1 piece</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Butter</td>
<td>1 tablespoon</td>
</tr>
<tr>
<td>Snack</td>
<td>10:00 am</td>
<td>Blue Diamond almonds</td>
<td>½ cup</td>
</tr>
<tr>
<td>Lunch</td>
<td>12:00 pm</td>
<td>Chipotle Burrito with Chicken</td>
<td>1 burrito</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Fajita veggies</td>
<td>3 ounces</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Sour Cream</td>
<td>4 tablespoons</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Fresh salsa</td>
<td>2 tablespoons</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Diet Coke</td>
<td>1 regular fountain drink</td>
</tr>
<tr>
<td>Snack</td>
<td>3:00 pm</td>
<td>Peanut butter luna bar</td>
<td>1 bar</td>
</tr>
<tr>
<td>Dinner</td>
<td>5:00 pm</td>
<td>Chicken and</td>
<td>6 ounces</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Rice cooked</td>
<td>2 cups</td>
</tr>
<tr>
<td>Snack</td>
<td>8:00 pm</td>
<td>Haagen-Dazs Ice Cream</td>
<td>2 cups</td>
</tr>
</tbody>
</table>
APPENDIX C

HEI Calculation

Has I calculated / Estimated HEI score

Using student 17 as an example.

Total kcal = 1879 = \( \frac{1879}{1000} \) = 1.8 per 1000 kcal equivalent

- Calculate each component to conform to the units of measure included in the index.

1) Total fruit = 2 1/2 cups = \( \frac{2.5}{1.8} \) = 1.4 cup eq/1000 kcal
   Standard for maximum score \( \geq 2.0 \) cup eq/1000 kcal
   Total fruit HEI score = 5

2) Whole fruit = 2 1/2 cups = \( \frac{2.5}{1.8} \) = 1.4 cup eq/1000 kcal
   Standard for maximum score \( \geq 2.0 \) cup eq/1000 kcal
   Whole fruit HEI score = 5

3) Total vegetables = 2 cups = \( \frac{2}{1.8} \) = 1.1 cup eq/1000 kcal
   Standard for maximum score \( \geq 1.1 \) cup eq/1000 kcal
   Total vegetable HEI score = 5

4) Greens and Beans = 2 cups = \( \frac{2}{1.8} \) = 1.1 cup eq/1000 kcal
   Standard for maximum score \( \geq 0.2 \) cup eq/1000 kcal
   Greens & Beans HEI score = 5

5) Whole grains = 3.5 oz = \( \frac{3.5}{1.8} \) = 1.9 oz eq/1000 kcal
   Standard for maximum score \( \geq 2.1 \) oz eq/1000 kcal
   Whole grains HEI score = 10
HEI Calculation (Continued)

6) Dairy = 0.5 cups = \( \frac{0.5}{1.8} = 0.3 \) cup eq/1000 kcal
   Standard for max score \( \geq 1.3 \) cup eq/1000 kcal
   Intake is less than standard
   \[
   \frac{0.3}{1.3} = 0.2 \text{ max score} \\
   0.2 \times 10 = 2
   \]
   Dairy HEI score = 2

7) Total protein foods = 24 oz = \( \frac{24}{1.8} = 13.3 \) oz eq/1000 kcal
   Standard for max score \( \geq 2.5 \) oz eq/1000 kcal
   Total protein HEI score = 5

8) Seafood & Plant proteins = 9 oz = \( \frac{9}{1.8} = 5 \) oz eq/1000 kcal
   Standard \( \geq 2.0 \) oz eq/1000 kcal
   Seafood & plant protein score = 5

9) Fatty acids = \( \frac{PUFA + MUFA}{SFA} = \frac{9 \text{ kcal} + 7 \text{ kcal}}{5 \text{ kcal}} \) = 3.2
   Standard \( \frac{PUFA + MUFA}{SFA} ) \geq 2.5
   Fatty acid score = 10

10) Refined grains = 0 oz
    Standard \( \leq 1.8 \) oz eq/1000 kcal
    Refined grains score = 10
HEI Calculation (Continued)

1) Sodium = 3064 mg
   \[
   \frac{3064 \text{ mg}}{1000} = 3.1 \text{ g} \quad \frac{3.1}{1.8} = 1.7 \text{g} \\
   \]

   **Standard:** ≤ 1.1 gram/1000 kcal
   - Intake is more than standard
   \[
   \frac{1.1}{1.7} = 0.65 \times 10 = 6.4 \\
   \text{Sodium HEI Score} = 6.4
   \]

2) Empty Calories = calories from solid fat, alcohol & added sugars

   **Solid Fat =** Sat fat + Trans fat
   \[
   = 35.12 \text{ g} + 0 \text{ g} \quad = 35.12 \text{ g} \times 9 = 316.08 \text{ kcal} \\
   \]

   **Alcohol =** No Alcohol

   **Added Sugar =** 0 g = 0 \times 4 = 0 kcal

   Empty calories = 316.08

   \[
   \text{Kcal from empty calories} = \frac{316.08 \times 150}{1819} = 17.9\%
   \]

   **Standard:** ≤ 19% of energy

   Empty calories = 20

   **Total score =** 5 + 5 + 5 + 5 + 10 + 2 + 5 + 5 + 10 + 10 + 6.4 + 20 = 88.4

   **Total HEI Score =** 88
APPENDIX D

HEALTHY EATING INDEX-2010 COMPONENTS AND STANDARDS FOR SCORING
APPENDIX D

Healthy Eating Index-2010 Components and Standards for Scoring

<table>
<thead>
<tr>
<th>HEI-2010 component</th>
<th>Maximum</th>
<th>Standard for maximum score</th>
<th>Standard for minimum score of zero</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Adequacy</strong> (higher score indicates higher consumption)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total Fruit</td>
<td>5</td>
<td>≥ 0.8 cup equiv. / 1,000 kcal&lt;sup&gt;10&lt;/sup&gt;</td>
<td>No fruit</td>
</tr>
<tr>
<td>Whole Fruit</td>
<td>5</td>
<td>≥ 0.4 cup equiv. / 1,000 kcal</td>
<td>No whole fruit</td>
</tr>
<tr>
<td>Total Vegetables</td>
<td>5</td>
<td>≥ 1.1 cup equiv. / 1,000 kcal</td>
<td>No vegetables</td>
</tr>
<tr>
<td>Greens and Beans</td>
<td>5</td>
<td>≥ 0.2 cup equiv. / 1,000 kcal</td>
<td>No dark-green vegetables, beans, or peas</td>
</tr>
<tr>
<td>Whole Grains</td>
<td>10</td>
<td>≥ 1.5 ounce equiv. / 1,000 kcal</td>
<td>No whole grains</td>
</tr>
<tr>
<td>Dairy</td>
<td>10</td>
<td>≥ 1.3 ounce equiv. / 1,000 kcal</td>
<td>No dairy</td>
</tr>
<tr>
<td>Total Protein Foods</td>
<td>5</td>
<td>≥ 2.5 ounce equiv. / 1,000 kcal</td>
<td>No protein foods</td>
</tr>
<tr>
<td>Seafood and Plant Proteins</td>
<td>5</td>
<td>≥ 0.8 ounce equiv. / 1,000 kcal</td>
<td>No seafood or plant proteins</td>
</tr>
<tr>
<td>Fatty Acids</td>
<td>10</td>
<td>(PUFAs + MUFAs) / SFAs ≥ 2.5</td>
<td>(PUFAs + MUFAs) / SFAs ≤ 1.2</td>
</tr>
<tr>
<td><strong>Moderation</strong> (higher score indicates lower consumption)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Refined Grains</td>
<td>10</td>
<td>≤ 1.8 ounce equiv. / 1,000 kcal</td>
<td>≥ 4.3 ounce equiv. / 1,000 kcal</td>
</tr>
<tr>
<td>Sodium</td>
<td>10</td>
<td>≤ 1.1 gram / 1,000 kcal</td>
<td>≥ 2.0 grams / 1,000 kcal</td>
</tr>
<tr>
<td>Empty Calories</td>
<td>20</td>
<td>≤ 19% of energy</td>
<td>≥ 50% of energy</td>
</tr>
</tbody>
</table>

Note: Adapted from *Center for Nutrition Policy and Promotion. U.S. Department of Agriculture, 2010*
APPENDIX E

RECRUITMENT E-MAIL
Hello,

My name is Mercy Nani, and I am a graduate student with Kent State University in the College of Education health and Human services (EHHS). I am currently working on my thesis research titled The Relationship between Nutrition Knowledge and Healthy Eating of College Students. Through this research I would like to examine diet quality as it relates to nutrition knowledge across two groups of college students (students who have had a nutrition class and students who are yet to have a nutrition class). I am writing to inquire if you would be willing to participate in my study.

If you chose to participate, you will be asked to complete an online anonymous 3-part survey that takes approximately 15 minutes to complete. The survey will ask you for demographic information, responses to true/false nutrition knowledge questions and to complete a 24-hr diet recall form.

Please click on this link to complete the study.

Your time and consideration is greatly appreciated. Your assistance is very conducive to the completion of this study. Please feel free to contact me at mnani@kent.edu or my advisor. Dr. Karen Lowry Gordon RD, LD, at klowry@kent.edu with any questions you may have.

Thank you,

Mercy Nani
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