

5-2012

Nutrition Knowledge and Attitudes Among Clemson University Freshmen

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NUTRITION KNOWLEDGE AND ATTITUDES AMONG CLEMSON UNIVERSITY
FRESHMEN

A Thesis
Presented to
the Graduate School of
Clemson University

In Partial Fulfillment
of the Requirements for the Degree
Master of Science
Nutrition

by
Jonathan Malcolm Unsworth
May 2012

Accepted by:
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ABSTRACT

This study was designed to assess the knowledge and attitudes of collegiate freshmen regarding nutrition principles and nutritional guidelines. Participants in this study were 73 first semester students at Clemson University. A questionnaire on nutrition knowledge and attitudes was distributed during the fall semester of 2010. The participants self-reported both height and weight.

The mean score on the knowledge questions was 12.25 points (SD= 2.73), or 49% correct responses. The mean score of the attitude questions was 5.92 points (SD= 1.50), or 65.7% correct responses. There was no significant difference in averages in knowledge and attitudes by gender, (P= .138) and (P= .103). There was no significant difference in the knowledge scores between BMI categories (P= .844). There was a significant difference between the attitude scores of the normal and the overweight/obese BMI categories (P< 0.0001), the underweight and the overweight/obese BMI categories (P< 0.0001), and the normal and underweight BMI categories (P= 0.0001). In line with a study published at Clemson University that assessed athlete nutrition knowledge and attitudes, the findings indicate the participants are not knowledgeable regarding recommended nutritional guidelines and general nutrition principles (Dunnigan, 2010). Future research should look at a larger sample size of college freshmen using instruments that include additional items on dietary choices to further define the role of nutrition education on knowledge and attitudes and strengthen the support for nutrition intervention strategies.

DEDICATION

This thesis is dedicated to my father, Malcolm Unsworth, who taught me to never give up. I also wish to dedicate this thesis to my mother, Elaine Unsworth, who never gave up on my dream for me to achieve this accomplishment.

ACKNOWLEDGMENTS

I would like to acknowledge the exceptional research efforts of Dr. M.E. Kunkel. Because of her contributions to the field, the intervention program for Clemson University may be realized.

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CHAPTER ONE

REVIEW OF LITERATURE

Research for the past decade has demonstrated patterns of weight gain in freshmen college students, but many questions are left unanswered regarding reasons for the weight gain and the role of various behavioral challenges including social, academic, financial, and eating on weight gain during their first year of college. Weight gain, ranging from 1.3 to 3.3 kg, during the first year of college has been observed in several studies, (Abood et al., 2000; Parmenter and Wardle, 2000).

The purpose of this study was to assess the knowledge and attitude of collegiate freshmen regarding specific nutrition principles and nutritional guidelines. First year Clemson University freshmen are the participants in this study. The information obtained will be important in developing recommendations for further interventions that are targeted at weight gain prevention for university freshmen. This chapter will review the literature in the areas of nutritional guidelines, weight gain observed for first year freshmen at college, transition to college life and risk of weight gain, and college freshmen as an important target population for weight gain prevention strategies.

Nutritional Guidelines

Chronic disease prevention has become an ever-growing concern over the last few decades. With the high rates of obesity and chronic diseases in the United States (RWJF and Trust for America's Health, 2009), the need to follow guidelines developed by the U.S. Department of Agriculture (USDA), the Centers for Disease Control and Prevention

(CDC), the Department of Health and Human Services and other governmental agencies has become imperative.

Daily Recommended Intakes

The Dietary Reference Intakes (DRIs) are quantitative estimates of nutrient intakes to be used for planning and assessing diets for healthy people. The DRIs include both recommended intakes and tolerable upper intake levels. The DRIs are determined by the Institute of Medicine, a private, non-profit organization that provides health policy advice under government funding to the National Academy of Sciences, and are utilized by many public agencies.

MyPlate

The USDA MyPlate replaced the MyPyramid in 2011 and is an educational tool designed to help people over 2 years of age make healthier food and physical activity choices. MyPlate is based on the Dietary Guidelines for Americans 2010 and represents the most current scientific information about diet and physical activity. The MyPlate symbol helps to conceptualize a healthy eating pattern by using a common method of serving food, the plate. By representing the different food groups using different colors and portion sizes, the new symbol educates the public on how to build a healthy plate of food. Each of the colors on the plate represents one of the five food groups from which to choose for good health:

- Green for vegetables and red for fruits; this makes up $\frac{1}{2}$ of the plate
- Orange for grains; this makes up $\frac{1}{4}$ of the plate
- Purple for protein; this makes up $\frac{1}{4}$ of the plate

- Blue for milk; a separate circle outside the plate represents a small serving of dairy

Fruits and Veggies – More Matters

The Fruits and Veggies – More Matters™ program replaced the 5 A Day program and is a health initiative that consumers might see in stores, online, at home and on packaging. Its focus is on promoting the benefits and importance of fruits and vegetables in a healthy diet. The Centers for Disease Control and Prevention (CDC) and Produce for Better Health Foundation (PBH) are leading this initiative in partnership with other health organizations.

Healthy Campus 2010

Healthy Campus 2010 uses leading health indicators and the subsequent health improvement goals within those indicators and applies those improvement goals to students on college campuses. The leading health indicators are originally identified by Healthy People 2010, led by the US Health and Human Services and the Institute of Medicine. The health indicators that apply to Healthy Campus 2010 include physical activity, overweight and obesity, tobacco use, substance use, responsible sexual behavior, mental health, injury and violence, environmental quality, immunization, and access to health care.

Weight Gain For Freshmen Entering College

Research indicates that first-year college students gain weight from a range of 3 to 9 pounds (Hoffman et al., 2005). Weight gain during the first year for university freshmen has been observed in many studies, listed in Table 1.1.

Table 1.1: Studies Showing Freshmen Weight Gain

Study	Length of study	Number of Participants	Mean Weight Gain or Change (lbs.)		
			Males	Females	Combined
Anderson et. al. (2003)	Sept. - Dec.	135			2.9
Anderson et. al. (2003)	Sept. - May	46			3.7
Economos et. al. (2008)	8-9 months	396	5.04	5.49	5.27
Edmonds et. al. (2008)	6-7 months	116 (female only)		5.3	
Hajhosseini et. al. (2006)	16 weeks	27			3
Hoffman et. al. (2006)	End of Sept. - End of April	67	2.91	2.82	2.87
Levitsky et. al. (2004)	12 weeks	60			4.18
Mihalopoulos et. al. (2008)	2 months	125	3.7	1.7	2.7
Racette et. al. (2005)	Academic year (Fall through Spring semesters)	118			5.5
Skornia et. al.	Academic year	188			1.76

Table 1.1 represents current research that found increases in weight.

All of the studies listed in Table 1 found increases in weight. While the actual average for freshmen weight gain remains debatable and varies across studies, a substantial number of studies conclude that the freshmen weight gain is real. The studies referenced in Table 1 identified that the freshmen experienced significant (but modest) weight increases their freshmen year in college (Anderson et. al, 2003). The data in the Levitsky et. al. (2004) study concludes the weight gain in this time period is significant rather than “modest” as some of the other studies conclude. However, these studies identified some limitations that include unexplained fluctuations in weight in the target population, possible differences in age in comparison groups, and not having enough data to explain which variables remained statistically significant in all statistical models of comparison and which did not (Anderson et. al, 2003; Levitsky et. al., 2004). Cluskey and Grobe (2009), Edmonds et al., (2008), Economos et al., (2008), challenge researchers that the actual average for how much weight is gained during the freshmen year still remains a mystery. Cluskey and Grobe’s data indicates that in their 2008 study, more than 25% of both college males and females gained more than 2.3 kg (5.06 pounds) of body weight in an 8-week period. Research by Hajhosseini et al., (2006) documents that freshmen students gain weight at a mean rate of 3 pounds in their freshmen year and reflect changes in diet, body composition and RMR. Although the amount of weight gain for freshmen does not seem to have a consensus in the field, most researchers agree that there is more to learn regarding the reasons behind this weight gain. The application of this information appears to be important in establishing methods that may, in the future, reduce or reverse the ‘epidemic’ of obesity observed in the general population. The

evidence to support that the actual average weight gain is 15 pounds remains debatable and inconclusive at this time (Mihalopoulos et al., 2008; Hoffman et al., 2004).

Weight Gain of Freshmen Entering College Tied to Behavior

Research that investigates behavior during the transition period from high school to college is needed (Mihalopoulos et al., 2008). “Weight gain appears to be common among young adults (Williamson et. al., 1990); future studies should include such a group to determine if the observed weight changes are related specifically to the college environment or are due to more general processes such as maturation or change in living environment” (Anderson et. al., 2003). Studies that have validated freshmen weight gain have prompted further research that explores factors about the transition from high school to college including changes in behavior and environment that may support weight gain. Edmonds et al., (2008) and Mihalopoulos et al., (2008) conclude that the time period from high school into the first year of college is significant for weight gain and there are mechanisms beyond gender, such as behavior and environment that deserve further concentration. Huang et al., (2003) used a convenience sample of 738 students who completed a questionnaire that explored overweight and obesity status, dietary habits, and physical activity. They reported that 21.6% of students were overweight and 6.9% were obese. The data showed that more than 69% of students reported <5 servings of fruits and vegetables/day and the authors state students were, “engaged in less than healthy dietary habits, such as low fruit and vegetable intake and low fiber intake, and low physical activity, suggesting the need for greater attention to diet and exercise interventions in this population” (Huang et al., 2003). Economos et al., (2008) showed

that alcohol consumption and academic pressures influenced poor diet and reduced physical activity.

Since 1989, researchers have been exploring factors such as adaptability, assimilation with peer groups, academic performance, and sense of community as factors that can influence how well or how poorly individuals transition into college life (Attinasi 1989; Padilla et al., 1997; Terenzini et al., 1994). The scope of research in sociology offers insight on strategies and behavior management noted over periods of time during the freshmen year for specific groups.

Current research establishes that weight gain in college is common and worthy of concern (Cluskey and Grobe, 2009; Shapiro and Lundgren, 2003). Cluskey and Grobe (2009) studied 379 college students and found the weight gains occurred early in college. Their research provides a basis that weight gain in college is common and that more research is needed to focus on attitudes and behaviors of students when they begin college. The study documents that sufficient research efforts are beginning to identify how stress and transition related behaviors affect weight gain. These stress and transition related behaviors, when making decisions regarding dietary choices, may even be gender specific.

Findings from the CDC on possible psychological and behavioral factors that may predict weight gain have been discussed for at least ten years (Butler et al., 2004; Economos et al., 2008). Yet, little is known about what changes in body composition occur and the possible connections between freshmen weight gain and its connections to health problems later in life (Hajhosseini et al., 2006).

Additional agreement among researchers reflects a commonly shared belief that behaviors and habits of first year college students can be linked to how they eventually treat their bodies in adulthood, which perhaps connects freshmen weight gain to being overweight or obese later in adulthood (Hajhosseini et al., 2006). The outcomes of current research reflect a call for further research that investigates and identifies causes behind the changes in body composition and more detail about the behavioral patterns during college that are potentially linked to composition changes (Racette et al., 2005). Hoffman et al., (2004) present data from questionnaires that included information on age, race, ethnicity, gender, meal plan and college. Their results were that the weight gain was 33% of “the mythical Freshmen 15” but strongly supported that stresses and changes in eating and exercise behavior are causes in the change in body composition (Hoffman et al., 2004). However, in the field of nutrition there is limited attention on potential relationships between college transition and weight status. Studies show that strategies exist and college freshmen do believe they develop strategies to deal with the life change that college brings. Some data points to patterns of attitudes and behaviors that students believe they needed to succeed in their 4-year programs (Clark, 2005). Conclusions from sociologists assert that specific strategies help students negotiate opportunities more effectively (Devine, 2005).

Transition experiences involve active development of coping strategies and behavior management. Gaining a better understanding of how freshmen cope with the transition will allow for development and implementation of more proactive strategies that may help to optimize their transition experiences (Devine, 2005).

For example, some researchers believe that the geographic change from homes to residence halls may provide students too little time to adjust properly (Freedman, 2010). Where students reside and how their residence life differs from their previous home are possible factors that influence dietary habits and weight gain (Freedman, 2010). Sociologists also make general recommendations to identify a need for interventions focused on the prevention of weight gain to address challenges freshmen face (Cousineau et al., 2004).

In a study that was done by Wengreen and Moncur (2009), they tracked 159 students enrolled at a mid-sized university. Each student's weight was measured at the beginning and end of the fall semester, and the participants also filled out a questionnaire about their diet, physical activity, and other health-related habits during the last six months of high school and the first semester at college. "In general, our findings are consistent with the findings of others who report the transition from high school to college promotes changes in behavior and environment that may support weight gain" (Wengreen and Moncur, 2009). The authors call for future studies to use methods that allow for comparisons across groups that may show how behaviors are and are not related to the college environment. In similar research with other investigators, it is noted that the exact causes behind what initiates changes in behavior leading to weight and fat gain need further research (Hoffman et al., 2006; Cluskey and Grobe 2009; Edmonds et al., 2008; and Anderson et al., 2003).

College brings tremendous pressure and limited accountability (Strong et al., 2008). Students entering college engage in a process of negotiation as they transition

from a family dynamic and established routine into a world with multiple freedoms and available choices (Terenzini et al., 1994). The abrupt lifestyle change and high levels of unawareness on the new pressures they face lead many freshmen to adapt poorly to academic environments (Sabia, 2007). One of the areas students mention as challenging is taking ownership of their physical well-being (Terenzini et al., 1994). Factors such as poor food choices, devaluing exercise, and academic pressures influence decision-making that may lead to poor physical well being in a short period of time, but may have a long-term impact on weight management (Strong et al., 2008). Cluskey and Grobe (2009) found that lack of commitment, minimal drive, and low sense of urgency contribute to poor health behavior. “Almost all subjects agreed that environmental influences impacted their current behaviors and, for some, the challenge in establishing or maintaining a healthful lifestyle was completely unanticipated. Lack of family support and absence of established routines and/or regular physical activity associated with previous sports involvement were described”. Racette et al. (2005) found that weight gain and behavioral patterns during college may contribute to overweight and obesity in adulthood. They assessed weight, exercise, and dietary patterns of 764 college students (53% women, 47% men) during freshmen and sophomore years. There were no apparent associations with exercise or dietary patterns and weight gain. Therefore, future research is needed to assess what the real contributors are in this observed weight gain and to determine the health implications of these findings.

Linking weight gain to knowledge of nutrition and dietary choices needs investigation

In addition to research that identifies lifestyle and behavior factors, there is a wide range of literature that demonstrates this target population performs poorly when graded on proper fruit and vegetable consumption (Adams and Colner, 2008). The “Position of the American Dietetic Association: Total Diet Approach to Communicating Food and Nutrition Information”, indicates that the lack of familiarity with MyPyramid modeled diets could be influencing weight gain outcomes and physical activity in female college freshmen, which has more to do with choices rather than behavior. Cluskey and Grobe (2009) identified education levels of nutrition as a possible influencing factor in freshmen weight gain. However, details on the types of choices and actions related to weight gain early in college is not sufficient. Cluskey and Grobe suggested weight gain and dietary choices are developmental, which validates efforts to study the current level of nutrition knowledge of freshmen in order to provide data that can later be used to compare to high school levels – and identify decision-making characteristics that can help better understand the impact of transition on student eating patterns.

Further validation for knowing the attitudes of college students about nutrition is presented in a study by Chambers and Young (2004). The authors linked caloric intake, physical activity and types of foods consumed to eating patterns that can lead to obesity. Their modeling identified patterns using groups or categories such as student attitudes towards nutrition and dieting conditions and found that many of the patterns were gender specific.

Parminter and Wardle (2000) indicated that many studies in this area have failed to explore significant associations between nutritional knowledge and dietary behavior.

Their efforts documented four areas that underlie the main aspects relating knowledge to dietary behavior. (1) Do people know what current expert dietary recommendations are? (2) Do they know which foods provide the nutrients referred to in the recommendations? (3) Can they choose between different foods to identify the healthiest ones? (4) Do they know what the health implications of eating or failing to eat particular foods are? This represents a more comprehensive assessment of nutrition knowledge than has generally been achieved. So in the same fashion, this questionnaire can provide useful data for examining the relationship between nutrition knowledge and dietary behavior (Parmenter and Wardle, 2000).

However, the current field of research does not offer much support about university freshmen's dietary choices, knowledge of nutrition, or attitudes about nutrition. In cases where researchers are studying these behaviors and linking diet choices to weight gain, the research is still not focusing on the role that attitudes and knowledge about nutrition may play in dietary choices that seemingly lead to weight gain in this time period (Butler et al., 2004). A total of 135 college students were weighed in September and December of their freshmen year and a subset also provided data in May. Results indicated that statistically significant but modest weight increases occurred during the freshmen year for most participants. The current research contributes information on the level of nutrition knowledge using questionnaire results that identify attitudes toward and knowledge of nutrition from a sample population of freshmen college students.

While there are research and professional briefs that explore college lifestyle, and environmental and personal factors related to weight gain (Levitsky et. al., 2004), a more in-depth investigation for findings that identify nutrition attitude and knowledge that guide these behaviors, needs to be performed before weight management strategies can be recommended (Anderson et al., 2003; Strong et al., 2008). Wengreen and Moncur (2009) draw awareness that the field lacks research on developmental changes and behavior during this transition period. While there is a sufficient pool of research that shows gender specific differences in weight gain, there are many other factors such as exercise, eating habits, nutrition knowledge and attitudes toward nutrition that are specific to the transition time from high school to college that need to be assessed. In the 2008 National College Health Assessment report, only 8.5% of students reported eating the recommended daily amounts of fruits and vegetables. While 45.5% report to be exercising a few days a week, that leaves more than 50% who may not be engaging in physical activity for wellness. When scores were provided for the types of information students reported receiving from their institutions, dietary behavior and nutrition education got a 32.5%.

While it is clear that a percentage of freshmen fail to meet guidelines for healthy lifestyles in their first year of college, results do not provide details that explain whether the weight gain is tied to behavior changes and/or knowledge levels about nutrition (Freedman, 2010; Hajhosseini et al., 2006). Results sufficiently reinforce theories that weight gain in college populations happens much more rapidly than similar aged men and women who are not in college (Strong et al., 2008). Several studies report that stresses

and changes in behavior are unique to the freshmen year of college (Hoffman et al., 2004). Data from the National College Health Assessment and the College Health Risk Behavior Questionnaire indicate that lack of exercise and poor eating habits are to blame for the 29.9% of students that are obese (Racette et al., 2008). In this study, projections of long-term weight gain and adverse health consequences outside of weight gain need to be assessed. Wengreen and Moncur (2009) asserted that research in the field identifies meals at all-you-care-to-eat dining facilities at college as an area that may also be contributing to weight gain. Choices freshmen make at dining halls can be directly related to their attitudes about nutrition and knowledge of proper nutrition. This questionnaire identifies freshmen levels of knowledge about nutrition to better understand possible links between knowledge of nutrition and freshmen weight gain.

Undergraduate college students are partaking in lifestyle choices that are putting them at risk for becoming overweight, such as a lack of physical activity and choosing foods that lack nutrients (Lowry et al., 2000). Cluskey and Grobe (2009) found that attitudes about weight and nutrition during the transition period from high school to college might have greater influence on weight gain than previously thought. Identifying these specific attitudes remains an area that needs further research.

College Students as an Important Target Population for Weight Gain Prevention

Strategies

According to the CDC, preventing weight gain and maintaining a healthy weight can help lower the risk of some chronic diseases, osteoarthritis and some forms of cancer. First-year college students are an at risk population for gaining a significant amount of

weight in a short period of time (Hoffman et al., 2006). Targeting this population could have an impact on reducing the overweight and obese population in U.S (Kumanyika, 2003). Racette et al. (2005) found that weight gain and behavioral patterns during college may contribute to overweight and obesity in adulthood. This area of research is related to connections sociologists make for the need to devise strategies to address challenges freshmen face (Cousineau et al., 2004).

Adoption of poor health behaviors during young adulthood can increase the risk of several chronic diseases, including obesity, type 2 diabetes, cardiovascular disease, and bone or joint complications. This suggests that the period between high school and the end of college is a critical time to intervene and educate young adults on the importance of developing and maintaining healthy behaviors (Adams and Colner, 2008).

In 2008, the U.S. Department of Education and National Center for Education Statistics reported that there were just over 3 million first-year college students. In addition, the 2007 National Health and Nutrition Examination Questionnaire, NHANES, estimated that more than 60% of those above the age of 20 are overweight or obese, while obesity rate of those aged 12-19 is only 18%. Finkelstein (2009) reported that the economic cost of obesity was around \$147 billion dollars. The increase in obesity from young teens and adults raises the question what exactly happens during passage from teen years into adulthood that leads to weight gain (Lewis, et al., 2000). A significant percentage in weight gain may begin the freshmen year of college (Mihalopoulos, 2008; Graham, 2002).

An effective strategy to further the prevention of obesity requires identifying significant periods of weight gain across human life spans (Anderson et al., 2003). Therefore, to further prevention of obesity, the field needs more research with freshmen students (Strong et al., 2008). In a limited number of studies, students have reported that information on nutrition is scarce compared to major issues such as tobacco use and alcohol abuse (Adams and Colner, 2008). Students are reportedly unaware of the relationships between dietary choices and long-term weight management. This suggests student populations may possibly benefit more from intervention programs that provide nutrition knowledge and coaching on how to make informed choices on campus and throughout their lives (Buscher et al., 2000). Hajhosseini et al., (2006) concluded that the weight gained in the first year of college can be significant enough to cause health issues related to metabolic syndrome over the long-term into adulthood. They documented severe changes in carbohydrate intake, which indicates that weight gain may be connected to dietary habits.

Types of Nutrition Education Specifically Geared to College Students

What defines a nutrition education program descends from 1943 research and activity performed by the American Academy of Political and Social Science. In order to further define the parameters of nutrition education programs most relevant to college students, this research focuses on common elements cited most often in the literature.

In studies targeting various segments of college populations, common components include the use of pre-tests and post-tests to measure nutrition knowledge before and after education programs (Abood and Black, 2000; Abood et al., 2004;

Collison et al., 1996; Kunkel et al., 2001; Zawila et al., 2003). A questionnaire developed by Werblow et al. (1978) was used in many of the studies, although most researchers altered the questions to fit their individual programs (Collison et al., 1996; Kunkel et al., 2001; Zawila et al., 2003). Werblow et al. (1978) and Abood et al. (2004) used questionnaires that averaged around 70 questions. An approach utilizing a peer nutrition education model was led by female students enrolled in the Didactic Program in Dietetics at Clemson University (Kunkel, 2001).

All of the studies reviewed used a pre-test to determine the initial knowledge of participants and most interventions took place in a group setting with the researchers implementing the programs. However, there is little to no research on the proper length for intervention programs nor on what factors lead to poor weight management after students complete programs. In conclusion, based on a literature review of current research, generally a program can be considered nutrition education if it measures the knowledge of participants prior to enrollment, provides programming to deliver improvements in dietary habits and/or reduction of weight gain, and measures the knowledge of participants prior to enrollment to gather data about the effectiveness of the program.

Support for the importance of building intervention programs is strong. Hoffman's long-term projections state, "For those students who experienced weight gain over the period we studied, if their energy balance is not controlled, they could potentially gain an average of 3 kg of body weight per year, placing them at risk for obesity and chronic diseases later in life" (Hoffman et al., 2006). Even research just

recently published in 2008 calls for universities to recognize the opportunity to promote wellness, physical activity, and proper dietary choices and integrate these elements into the core course work (Racette et al., 2008). Most notable researchers in the area of nutrition intervention programs for athletes, Sloan et. al. ((1976), Skinner (1991) and Matvienko, et al. (2001) found make connections that enrollment in nutrition courses is effective for female athletes, but not for males. Sloan et al., (1976) implemented a 12-week program for students that required education on eating healthy with practical application on how to maintain their weight using resources on campus. Students in the program lost weight. Studies involving nutrition related intervention programs via nutrition course enrollment include Matvienko et al., (2001), Skinner (1991), Hudiburgh (1984), and Levitsky et. al. (2006) all with results showing a reduction in weight gain compared to populations not enrolled in the nutrition related courses. The nutrition course seemed to impact students choices in the areas of calorie consumption and fat intake. These intervention programs did not focus on controlling physical activity or environmental factors like academic pressure that may also play a role in freshmen weight gain. However, Hudiburgh's (1984) program integrated nutrition education with 3 hours of exercise, but only three hours per week of exercise were required. In both programs, follow up was not maintained to measure any long-term effectiveness. Levitsky et. al. (2006) targeted females only and used an algorithm called the "tissue monitoring system", and while it was effective to help girls maintain their body weight, the consequences of focusing on their weight could be counterproductive emotionally and physically. Intervention programs that focus on physical exercise in this same target

population seems to be more effective than nutrition focused programs. Results include improved attitudes about exercise, improvements in fitness and strength, and successful weight management. However, none of the above intervention programs involved a curriculum designed for long-term follow up and maintenance that would encourage success from the first year up to graduation. Attitudes toward being ready to exercise influenced success in the physical activity intervention programs, which shows the importance of understanding student attitudes towards all factors that drive wellness. Out of the most referenced programs presented in this literature review, the results show that what is missing is a long-term maintenance program that integrates nutrition education, education, awareness, and promotion of physical activity, and health-related information provided by a network of health professionals.

Efforts by institutions to provide tailored weight management and weight gain prevention programs are increasing. Morrell (2011) used electronic questionnaire data to establish that college students are receptive to learning more about weight management and nutrition on line. She drew connections between current intervention programs and effectiveness rates asserting that program curricula could better engage student populations by using web-based applications. Nutrition education programs often begin with a pilot version. At Utah State University, junior-level dietetic students launched a nutrition education intervention for first-year students that showed a positive impact on reducing the opportunity for weight gain for those that participated in the class. Using focus groups and student-to-student instruction programs, weight gain for those that were enrolled in education programs was minimized compared to those who did not

enroll in nutrition programs. The outcomes of this group study and instruction build a strong connection between nutrition knowledge and weight management. Thus, it is important to measure freshmen knowledge of nutrition and attitudes so that we have the information we need to develop programs that can prevent weight gain and fight obesity in later adulthood.

Rationale

Much of the research about weight gain in college has focused on incoming freshmen and the subsequent weight gain during their first two semesters. Studies that look at freshmen nutrition knowledge and attitudes are very limited. Therefore there is a need to explore incoming freshmen levels of nutrition knowledge and their attitudes toward nutrition in order to help determine the need for a nutrition intervention program.

This study assessed levels of nutrition knowledge and attitudes of incoming freshmen on recommended nutritional guidelines and general nutrition principles. High and low performers were qualitatively compared to determine if there are differences in the number of correct responses among knowledge questions. Comparisons were made on questions for which at least 50% of the responses were incorrect among the high performers (Dunnigan, 2010).

Additionally, the research hypotheses of this study:

- Males and females will have different knowledge scores.
- Males and females will have different attitude scores.
- Underweight BMI, normal weight BMI and overweight/obese BMI knowledge scores will differ.

- Underweight BMI, normal weight BMI and overweight/obese BMI attitude scores will differ.

CHAPTER TWO

MATERIALS AND METHODS

This study was designed to assess the knowledge and attitude of collegiate freshmen regarding specific nutrition principles and nutritional guidelines. Validated by a questionnaire used in a published study at Clemson University, “Nutrition Knowledge and Attitudes Among Clemson University Student Athletes”, the main concepts within this questionnaire are:

- Vitamins are not a source of energy but supplements act comparably to naturally occurring vitamins in foods.
- Protein is found in many sources besides meat.
- Nutrient dense foods are foods that have a large amount of nutrients relative to the number of calories per serving.
- Energy dense foods are foods that have a large amount of calories per serving.
- Some types of serum cholesterol are beneficial.
- Fiber is found in many plant sources and has many positive health benefits.
- Water is the best way to rehydrate during physical activity and hydrating slowly throughout the event is better than drinking large amounts at one time.
- Losing weight is based on total calories in and calories out, therefore, eliminating a food group all together is not an effective weight management strategy.
- It is important to be aware of nutritional concepts in everyday life.

The purpose of this study is to measure nutrition knowledge and attitudes of university freshmen. A questionnaire was developed that contains 25 knowledge statements and 9 attitude statements. This questionnaire was developed in partnership with published researchers and experts in the field of nutrition at Clemson University. In

the questionnaire, the knowledge statements are 1-18 and questions 20-23, 25, 26, and 28 (Appendix A). The attitude statements are 19, 24, 27, 29, 30, 31, 32, 33, and 34 (Appendix A).

Design of the Instrument

Common questionnaire instruments used in the field are vague and difficult to relate to measuring knowledge and attitude specific to nutrition. In order to create data meaningful and appropriate for this thesis, a new instrument with questions that targeted specific attitudes and knowledge was developed. While the majority of the knowledge and attitude statements are unique to this new instrument, the statements were modeled after a similar peer reviewed validated and reliable instrument by Zawila et al., (2003) and extracted items 2, 4, 6, 8, 12, 13, 16, 23, 24, 26, 33 and 34 (Appendix A), using them without modification.

Validity

The questionnaire was peer reviewed by participants within the graduate program for Nutrition. Also, graduate students engaged in feedback that shaped the questionnaire and published experts at Clemson University reviewed the questionnaire to validate readability and basic knowledge concepts. Feedback from academic experts included a professor with subject matter expertise in instrument design. A thorough review of statements was conducted that involved an idea exchange on best practices for balancing the messaging of statements to avoid any bias for answers to lean in any particular direction. Following this thorough review and shaping of the instrument, the questionnaire was distributed to graduate students from various degree programs in order

to demonstrate the statements in the questionnaire are clear, simple to understand, and tailored to achieve the goals for creating meaningful data. In this final review process, no changes were necessary.

This study protocol was reviewed by the Institutional Review Board (IRB) of Clemson University and was determined to be exempt. The questionnaire was determined to be exempt because all participants would be limited to 18 years and older and all personal information would remain anonymous. Participants were at no risk of being identified publicly or having information personal to them shared publicly without consent. Data collection was performed in September in the fall 2010 semester following IRB approval.

Participants

The participants were first year college freshmen who attended Clemson University during the 2010-2011 Academic Year (n=73).

General Procedures

Students were recruited while dining at University dining halls and by an e-mail that was distributed to the entire freshmen body via listserv. There were no incentives given to participants to complete this questionnaire. Questionnaire details were explained to each participant as to what would be involved in the task of the questionnaire and how their responses were planning to be used. At this time the freshmen students were given the opportunity to ask any questions pertaining to the research and to decline participation. Students who chose to participate were given a copy of an informational letter and the questionnaire (Appendix B). Participants were instructed not to place their

name or any identifying demographic information on the questionnaire. Since the questionnaire was administered using pencil and paper, it was not possible to link an individual to a specific questionnaire. Participants were asked to self-report height and weight. Questionnaires completed online through surveymonkey.com were password protected. Completed questionnaires were stored in a cabinet within a locked lab. Only members of the research team had access to the data.

Data Analysis

Microsoft Excel for Windows was used to perform all statistical analyses for this study. Frequencies for demographic information, such as gender and BMI, were determined. Means were calculated for knowledge and attitude items on the questionnaire.

Two sample t-tests were used to compare knowledge and attitude among males and females. Analysis of variance (ANOVA) was used to compare knowledge and attitudes among underweight, normal weight and overweight/obese BMI categorizations. Statistical results were considered to be significant at $p < 0.05$. High and low performers were qualitatively compared to determine if there are differences in the number of correct responses among knowledge questions. Comparisons were made on questions for which at least 50% of the responses were incorrect among the high performers (Dunnigan, 2010).

CHAPTER THREE

RESULTS AND DISCUSSION

Response Rate

A total of 73 participants completed the questionnaire. The data collection took place during the fall semester of 2010. The original electronic distribution of the questionnaire was compromised because the link to the questionnaire was not functioning correctly. The results of the first distribution equaled 33 responses. To strengthen the sample size, an additional 40 responses were acquired on a volunteer basis using a convenience sample within the dining hall. To determine the response rate, the admission numbers for 2010 found within the Clemson University Institutional Research were used. The response rate for this group is approximately 2.5%. The number of questionnaires collected within the dining hall might have been greater if the questionnaire was administered during a dinner period where students have more time to fill it out. Also, the length of the questionnaire and the number of questionnaire questions also may have contributed to the low response rate.

Demographics

All participants were first year college freshmen on a meal plan. College freshmen at Clemson University are required to have a meal plan. The questionnaire was administered in the dining halls as well as by e-mail to first year college freshmen. Out of 73 respondents, 33 were female (45%) and 40 were male (55%). In Table 2, Body Mass Index (BMI) by gender is shown. Approximately 70% of all participants fell into a normal BMI categorization (n=51). Since there were only 2 participants that fell into an

obese BMI categorization, they were grouped together with the overweight BMI categorization for purposes of analysis.

Table 2.1: BMI Categorizations By Percentage and Gender

<i>BMI</i>	<i>Classification</i>	<u>Total</u>		<u>Female</u>		<u>Male</u>	
		<i>n</i>	<i>%</i>	<i>n</i>	<i>%</i>	<i>n</i>	<i>%</i>
< 18.5	Underweight	5	6.8	4	5.5	1	1.4
18.5 - 24.9	Healthy/Normal Weight	51	69.9	22	30.1	29	39.7
25 - 29.9	Overweight	15	20.5	7	9.6	8	11.0
≥ 30	Obese	2	2.7	0	0.0	2	2.7

Table 2.1 shows the males and females BMI categories.

Analysis of the Questionnaire

In this study, results are evaluated the following ways:

1. as a whole using descriptive statistics;
2. a summative presentation using a dichotomous scale showing specific results for all 34 questions;
3. T-tests to compare knowledge and attitude scores between male and females; and
4. Analysis of variance (ANOVA) to compare knowledge and attitude scores among underweight, normal weight and overweight/obese BMI categorizations.
5. Qualitative comparison of high and low performers with number of correct responses among knowledge questions

Knowledge and attitude scores

Twenty-five of the 34 items on the questionnaire were knowledge questions (Appendix A). The total mean score for the knowledge questions was 12.25 points (SD= 2.73), or 49% correct responses. The mean score for the male freshmen was 11.93 points (SD= 2.61) or 47.7% correct responses. The mean score for the female freshmen was 12.64 points (SD= 2.87) or 50.6% correct responses. The mean score for the male and female freshmen that were: underweight was 12.20 points (SD= 1.92) or 48.8% correct responses, normal weight was 12.14 points (SD= 2.60) or 48.6% correct responses and overweight/obese was 12.59 points (SD= 3.37) or 50.3% correct responses.

Nine of the 34 items on the questionnaire were attitude questions (Appendix A). The total mean score for the attitude questions was 5.92 points (SD= 1.50) or 65.7% correct responses. The mean score for the male freshmen was 5.73 points (SD= 1.80) or 63.7% correct responses. The mean score for the female freshmen was 6.15 points (SD= 1.00) or 68.3% correct responses. The mean score for the male and female freshmen that were: underweight was 7.00 points (SD= 1.00) or 77.8% correct responses, normal weight was 6.14 points (SD= 1.36) or 68.2% correct responses and overweight/obese was 4.94 points (SD= 1.60) or 54.9% correct responses.

Table 3.1: Knowledge Questions with Number of Correct Responses

Item	Female (n= 33)	Male (n=40)	
1	Soft margarine contains less fat than butter.	14	22
2	Vitamins are a good source of energy.	6	7
3	There is more protein in a glass of whole milk than in a glass of skimmed milk.	16	13
4	Dark colored vegetables have more nutritional value than light colored vegetables.	24	27
5	Hamburgers and French fries are nutrient dense.	30	33
6	Eggs, beans, nuts and milk are examples of protein sources other than meat.	32	38
7	Fruits and vegetables are nutrient dense.	31	36
8	Fresh, frozen, and canned vegetables all have similar nutrient values.	8	9
9	LDL is also known as the good cholesterol.	4	9
10	Decreasing intake of dietary carbohydrate poses no health risk.	20	25
11	Peanut butter is a good source of cholesterol.	9	8
12	Fiber in the diet may help to decrease blood cholesterol levels.	30	37
13	Bread and cereals is the only food group that is a good source of fiber.	30	33
14	Increasing intake of dietary protein poses no health risk.	17	12
15	Obtaining between 50-60% of your daily calories from carbohydrate is recommended as part of a healthy diet.	15	18
16	Thirst is an adequate guide to the need for fluids.	13	19
17	Foods rich in omega-3 fatty acids help prevent heart disease.	24	30
18	Fruits and vegetables are energy dense.	6	4
20	Vitamins in fortified foods are not used by the body as well as naturally occurring vitamins from foods.	1	2
21	Obtaining about 20% of your daily calories from protein is recommended as part of a healthy diet.	30	26
22	Eating a variety of whole grain products ensures an adequate fiber intake.	2	1
23	Sports drinks are the best way to replace body fluids lost during exercise.	19	23
25	Hamburgers and French fries are energy dense.	6	12
26	Trans fat does not increase risk of chronic disease if consumed in moderation.	16	16
28	There is no health risks associated with lowering the amount of fat you eat every day.	14	17

Table 3.1 show the correct responses by gender for the knowledge questions.

Questionnaire Items Most Frequently Answered Incorrectly

The items that the participants answered frequently incorrect and the percentage of incorrect responses (50% or more incorrect) are as follows:

2. Vitamins are a good source of energy. (82.19%)
3. There is more protein in a glass of whole milk than in a glass of skim milk.
(62.7%)
8. Fresh, frozen, and canned vegetables all have similar nutrient values. (76.71%)
9. LDL is also known as the good cholesterol. (82.19%)
11. Peanut butter is a good source of cholesterol. (76.71%)
14. Increasing intake of dietary protein poses no health risk. (60.27%)
15. Obtaining between 50-60% of your daily calories from carbohydrate is recommended as part of a healthy diet. (54.79%)
16. Thirst is an adequate guide to the need for fluids. (56.16%)
18. Fruits and vegetables are energy dense. (86.30%)
20. Vitamins and fortified foods are not used by the body as well as naturally occurring vitamins from foods. (95.89%)
22. Eating a variety of whole grain products ensures an adequate fiber intake.
(95.89%)
25. Hamburgers and French fries are energy dense. (75.34%)
26. Trans fat does not increase risk of chronic disease if consumed in moderation.
(56.16%).

28. There is no health risks associated with lowering the amount of fat you eat everyday. (57.53%)

Cluskey and Grobe (2009) identified education levels of nutrition as a possible influencing factor in freshmen weight gain and the results indicate a poor level of nutrition knowledge in this target population. Freshmen could be choosing foods that are rich in energy but empty in nutrients. The scores are consistently low on fruit and vegetable intake which shows that it is likely they may not know enough about energy and nutrient dense foods to appropriately compensate for the calories, which Levitsky et. al.'s (2004) research supports can be a contributing factor in freshmen weight gain. The number of incorrect responses in the knowledge section further reinforces that the need to study the relationship between nutrition knowledge and dietary behavior is valuable. The low scores in nutrition knowledge also support Parminter and Wardle (2000) and indicate that many studies in this area have failed to explore significant associations between nutritional knowledge and dietary behavior to answer whether freshmen actually have enough knowledge to discern which foods provide recommended nutrients and are capable of identifying or locating them in settings like a dining hall. Proper consumption of food begins with a basic understanding of the recommended daily allowances per food group. The number of incorrect responses reinforces prior research findings that this target population does not score well in knowledge of recommended servings of nutrient dense foods (Racette et. al, 2008).

The knowledge statements, “Fruits and vegetables are energy dense”, and “Hamburgers and french fries are energy dense” were scored poorly by both high and low

performers. In a similar study using the same questionnaire at Clemson University that targeted freshmen athletes (Dunnigan, 2010), the results were consistent with the incorrect responses in this sample. These questions are a part of a series of four questions that tests the concept of nutrients relative to calories. The counterparts to these two questions, “Hamburgers and french fries are nutrient dense” and “Fruits and vegetables are nutrient dense” were answered correctly by 94% of the high performers for both questions and 92% and 86% of all participants, respectively. This may indicate that the concept of energy density is not well grasped by incoming freshmen and may help explain why freshmen have been observed gaining weight. Conversely, this may also indicate a poorly phrased question. In future studies, replacing the term energy dense with calorie dense may result in higher scores for those questions.

Table 3.2: Attitude Questions with Number of Correct Responses

Item		Female (n=33)	Male (n=40)
19	There is a relationship between good eating habits and good health.	33	38
24	All physically active people should take vitamins.	5	10
27	Skipping meals is okay if you need to lose weight quickly.	32	35
29	The only time it is important to be aware of caloric intake is when you are trying to gain or lose weight.	32	30
30	Eating two meals or more per day will have a positive effect on mental and physical performance.	31	32
31	A key factor in weight loss is eating more protein.	6	11
32	The most effective weight loss method is to eat fewer calories per day.	14	16
33	Physically active people need to be more concerned with nutrition than non-active individuals because of its effect on performance.	19	23
34	During exercise it is better to drink lots of fluid all at once than to drink in small amounts over a period of time.	31	34

Table 3.2 shows the correct responses by gender for the attitude questions.

Evaluation of Attitude Responses

Attitude responses were consistent with the outcomes from a similar study using the same instrument published in 2010 at Clemson University (Dunnigan, 2010). Findings continue to be consistent with researchers (Jonnalagadda et al., 2001) that students believe that vitamins are a good source to increase energy levels. Again, in parallel with the knowledge category, there is not a noticeable range of variability in comparing the gender populations.

The items that the participants answered frequently incorrect and the percentage of incorrect responses (50% or more incorrect) are as follows:

24. All physically active people should take vitamins. (79.45%)

31. A key factor in weight loss is eating more protein. (76.71%)

32. The most effective weight loss method is to eat fewer calories per day.
(58.90%)

The students answered a majority of the attitude questions correctly. Food choices freshmen make can be directly related to their attitudes about nutrition and knowledge of proper nutrition. The attitudes of subjects in this study were positive towards awareness of the benefits of physical activity and eating for the purpose of building energy to be physically active.

Further validation for knowing the attitudes of college students about nutrition is presented in a study by Chambers and Young (2008) linking caloric intake, physical activity and types of foods consumed to eating patterns that can lead to obesity. Their modeling identified patterns using groups or categories such as student attitudes towards

nutrition and dieting conditions and found that many of the patterns were gender specific. While this data does not show any significant gender specific patterns, student attitudes toward caloric intake reflects a strong awareness of the relationship of calories to physical performance.

The two questions that received the poorest scores include question 24 (“All physically active people should take vitamins.”) and question 31 (“A key factor in weight loss is eating more protein.”) are consistent with the incorrect responses to the knowledge question 2 (“Vitamins are a good source of energy.”) showing that the knowledge and attitudes towards understanding vitamin consumption is poor. The majority (71%) scored correctly for the association between good eating and good health. The strength of the correct responses in this category indicate that knowledge of nutrition plays a greater role in freshmen weight gain than attitudes towards nutrition, which makes the current calls for further research more valid. The incorrect responses to question 31 (“A key factor in weight loss is eating more protein.”) in the attitude section and question 14 (“Increasing intake of dietary protein poses no health risk.”) from the knowledge section show a consistent lack of understanding for the macronutrient protein.

Statistical Analysis

Two sample t-tests were used to compare nutrition knowledge and attitude between genders. In this study, there is insufficient evidence to suggest that the average knowledge score for male students is different from that of the female students ($P = .138$). Likewise, there is insufficient evidence to suggest that the average attitude scores for male students is different from that of female students ($P = .103$). While the data does not

reflect any gender specific differences between knowledge and attitude scores between the males and females as would be expected by researchers like Chambers and Young, the poor results show a pattern indicating a need for improvement in knowledge of nutrition.

An ANOVA test was used to determine if there were any differences in knowledge and attitude scores for categories of BMI. There was no evidence to suggest any difference in scores in nutrition knowledge between underweight, normal weight and overweight/obese BMI categories ($P=.844$). There was a significant difference between the attitude scores of the normal and the overweight/obese BMI categories ($P< 0.0001$), the underweight and the overweight/obese BMI categories ($P< 0.0001$), and the normal and underweight BMI categories ($P=0.0001$). A two sample t-test was performed on each BMI category to determine which pair was different. There was evidence to suggest that the attitude scores between normal weight and overweight/obese participants were different ($P< 0.0001$), underweight and overweight/obese were different ($P< 0.0001$) and normal and underweight BMI categories ($P=0.0001$) were different.

The BMI percentage in this study for underweight, normal weight, and overweight/obese lined up well with the findings in the American College Health Association-National College Health Assessment (ACHA-NCHA) (2008) report for the same BMI categorizations. Since the results of the analysis of variance (ANOVA) test showed that there was no evidence to suggest any difference in scores in nutrition knowledge between underweight, normal weight and overweight/obese BMI categories ($P=.844$), this may show that BMI is not a predictor nutrition knowledge score. Future

research should repeat the questionnaire on knowledge of nutrition, attitudes about nutrition, BMI and gender using a larger sample size to determine if these findings are supported.

Table 4.0: High and Low Performer Comparison of Percent Correct for Knowledge Questions

Item	High Performer (% correct)	Low Performer (% correct)	All Respondents (% correct)
2. Vitamins are a good source of energy.	50	0	18
8. Fresh, frozen and canned vegetables all have similar nutrient values	50	6	23
9. LDL is also known as the good cholesterol.	33	11	18
11. Peanut butter is a good source of cholesterol.	44	6	77
18. Fruits and vegetables are energy dense.	22	0	14
20. Vitamins in fortified foods are not used by the body as well as naturally occurring vitamins from foods.	6	0	4
22. Consuming a variety of whole grain products ensures an adequate fiber intake.	6	0	4
25. Hamburgers and french fries are energy dense.	44	11	44

Table 4.1 shows the percentage of correct responses for knowledge questions comparing high and low performers and a column showing all respondents.

Evaluation of High and Low Performers

Scores were broken up into two categories, high performers and low performers. Using the upper quartile and lower quartile as reference, high performance was defined as scoring 14 or more correct responses on the knowledge questions and low performance was defined as scoring 9 or less correct responses on the knowledge questions. There were 18 high performers and 9 low performers. Comparisons were made on questions for which at least 50% of the responses were incorrect among the high performers (Dunnigan, 2010). Table 4 shows the results of this comparison.

When comparing the high and low performers qualitatively, the low performers did not select a correct response in 4 of the 8 questions. Questions 2, 9, 18, 20, and 22 all had less than 20% of all respondents answer correctly. Even the high performers scored poorly in these same concepts, being vitamins and energy, beneficial cholesterol, energy density and sources of fiber, with overlap of the low performers receiving a 0% correct in questions 18, 20 and 22.

Limitations

The poor response rate and the subsequent limited sample size was the major limitation. The number of respondents within this target population would need to be expanded. Also, when using Likert scales, interpretation of the data is left to individual interpretation.

CHAPTER FOUR

CONCLUSIONS

Consistent throughout the study was a lack of knowledge among the Clemson University freshmen. The freshmen scored poorly on nutrition knowledge, as the total mean score for the knowledge questions was 12.25 points (SD= 2.73), or 49% correct responses. The same conclusion can be made, when scores are separated by gender, as the mean score for the male freshmen was 11.93 points (SD= 2.61) or 47.7% correct responses and the mean score for the female freshmen was 12.64 points (SD= 2.87) or 50.6% correct responses. The freshmen also scored poorly on the attitude section, as the total mean score for the attitude questions was 5.92 points (SD= 1.50) or 65.7% correct responses. The participants also have poor attitudes toward nutrition. When scores are separated by gender, the mean score for the male freshmen was 5.73 points (SD= 1.80) or 63.7% correct responses and the mean score for the female freshmen was 6.15 points (SD= 1.00) or 68.3% correct responses.

Within the scope and limitations of this study, it seems reasonable to conclude that:

- There was insufficient evidence to suggest that the average knowledge score for male students is different from that of the female students ($P = .138$).
- There was insufficient evidence to suggest that the average attitude scores for male students is different from that of female students ($P = .103$).

- There was insufficient evidence to suggest any difference in scores in nutrition knowledge between underweight, normal weight and overweight/obese BMI categories (P=.844)
- There was a significant difference between the attitude scores of the normal and the overweight/obese BMI categories (P< 0.0001), the underweight and the overweight/obese BMI categories (P< 0.0001), and the normal and underweight BMI categories (P=0.0001)

Recommendation for Further Research

The following recommendations for future research, based on the current data are as follows:

- Further research that investigates knowledge, attitudes and dietary choices among university freshmen to help tie behavior and actual food selections to knowledge and attitudes
- The effect of nutrition education programs for incoming freshmen on the following subject: (1) General Health; (2) Nutrients, vitamins & energy; (3) Protein; (4) Carbohydrate and fiber; and (5) Fat to determine how that impacts dietary choices
- A study that compares university freshmen weight changes and weight changes in a similar age group that are not in the university setting
- Further research that compares dietary choices and weight changes of high school students that go through a nutrition education and do not go through a nutrition education program before coming to university

Implications

The Body Mass Index (BMI) categorizations in this study indicate that about 23% are overweight and obese. Based on the field of research, we know that the target population is at risk for weight gain. The 2008 American College Health Association-National College Health Assessment (ACHA-NCHA) report states that approximately 32% of college students are overweight and obese, while the “F as in Fat” report states that more than two-thirds of the general population in the United States is overweight and obese (RWJF and Trust for America's Health, 2009). Prevention of weight gain in early adulthood is potentially critical in long-term weight management across the human life span. Therefore, focusing on knowledge of nutrition outside of its connectedness to BMI is important, as there was no difference among the BMI categories in the knowledge scores seen in this study.

University freshmen levels of knowledge and actual food intake need more focus. Using the same questionnaire as used in this study as well as an instrument that will document food intake could present a clearer picture of the connections between knowledge of nutrition as a contributor to proper dietary choices. Doing so would produce stronger data to further strengthen the need for prevention strategies and nutrition-focused curriculum for college freshmen.

Based on this study’s results, a focus on education in the areas of vitamins and energy, beneficial cholesterol, energy density and sources of fiber is particularly important, in order to educate university freshmen about proper caloric consumption and proper dietary guidelines. Hoffman et. al. (2003) supports that intervention / education programs combine a nutrition-focused curriculum with practical applications of energy

balance. Research by Sloan et. al. (1976) on their 12-week program indicates that success factors for nutrition education programs need to be long-term with hands-on practical application of resources that proactively contribute to weight maintenance on campus. The efforts of Matvienko et al. (2001), Skinner et. al. (1976), Hudiburg (1984), and Levitsky et. al. (2004) support that nutrition education should be introduced as a core course requirement for freshmen. Morrell's (2011) research strongly positions that core courses should be offered online to best engage freshmen with nutrition focused education.

APPENDICES

Appendix A

Questionnaire

Please provide information as indicated:

1. Are you:
 - a. Male
 - b. Female

2. What is your:

_____ Height

_____ Weight

3. What is your education level?
 - a. Freshmen
 - b. Sophomore
 - c. Junior
 - d. Senior
 - e. Graduate

Some statements concerning nutrition are given below. Please indicate your reaction to each statement by selecting the number that best describes how you feel about the statement.

- 1 - If you strongly agree (SA)
- 2 - If you agree (A) but do not feel strongly about the statement
- 3 - If you are undecided (U) or neither agree or disagree
- 4 - If you disagree (D) but do not feel strongly about the statement
- 5 - If you strongly disagree (SD)

		SA	A	U	D	SD
1	Soft margarine contains less fat than butter.	1	2	3	4	5
2	Vitamins are a good source of energy.	1	2	3	4	5
3	There is more protein in a glass of whole milk than in a glass of skimmed milk.	1	2	3	4	5
4	Dark colored vegetables have more nutritional value than light colored vegetables	1	2	3	4	5
5	Hamburgers and French fries are nutrient dense.	1	2	3	4	5
6	Eggs, beans, nuts and milk are examples of protein	1	2	3	4	5

	sources other than meat.					
7	Fruits and vegetables are nutrient dense	1	2	3	4	5
8	Fresh, frozen, and canned vegetables all have similar nutrient values.	1	2	3	4	5
9	LDL is also known as the good cholesterol.	1	2	3	4	5
10	Decreasing intake of dietary carbohydrate poses no health risk.	1	2	3	4	5
11	Peanut butter is a good source of cholesterol.	1	2	3	4	5
12	Fiber in the diet may help to decrease blood cholesterol levels.	1	2	3	4	5
13	Bread and cereals is the only food group that is a good source of fiber.	1	2	3	4	5
14	Increasing intake of dietary protein poses no health risk.	1	2	3	4	5
15	Obtaining between 50-60% of your daily calories from carbohydrate is recommended as part of a healthy diet.	1	2	3	4	5
16	Thirst is an adequate guide to the need for fluids.	1	2	3	4	5
17	Foods rich in omega-3 fatty acids help prevent heart disease.	1	2	3	4	5
18	Fruits and vegetables are energy dense.	1	2	3	4	5
19	There is a relationship between good eating habits and good health.	1	2	3	4	5
20	Vitamins in fortified foods are not used by the body as well as naturally occurring vitamins from foods.	1	2	3	4	5
21	Obtaining about 20% of your daily calories from protein is recommended as part of a healthy diet.	1	2	3	4	5
22	Eating a variety of whole grain products ensures an adequate fiber intake.	1	2	3	4	5
23	Sports drinks are the best way to replace body fluids lost during exercise.	1	2	3	4	5
24	All physically active people should take vitamins.	1	2	3	4	5
25	Hamburgers and French fries are energy dense.	1	2	3	4	5

26	Trans fat does not increase risk of chronic disease if consumed in moderation.	1	2	3	4	5
27	Skipping meals is okay if you need to lose weight quickly.	1	2	3	4	5
28	There is no health risks associated with lowering the amount of fat you eat every day.	1	2	3	4	5
29	The only time it is important to be aware of caloric intake is when you are trying to gain or lose weight.	1	2	3	4	5
30	Eating two meals or more per day will have a positive effect on mental and physical performance.	1	2	3	4	5
31	A key factor in weight loss is eating more protein.	1	2	3	4	5
32	The most effective weight loss method is to eat fewer calories per day.	1	2	3	4	5
33	Physically active people need to be more concerned with nutrition than non-active individuals because of its effect on performance.	1	2	3	4	5
34	During exercise it is better to drink lots of fluid all at once than to drink in small amounts over a period of time.	1	2	3	4	5

Appendix B
Informational Letter

**Information for Participation in a Research Study
Clemson University**

**Assessment of nutrition knowledge and attitudes
among Clemson University freshmen students.**

You are invited to participate in a research study conducted by Dr. Beth Kunkel along with Jon Unsworth. The purpose of this research is to further understand the level of nutritional knowledge and attitudes toward eating among university freshmen. This study will also allow researchers to gain a better understanding of students' attitude and approach towards eating and to design programs that may benefit students.

Your participation will involve filling out a questionnaire about your knowledge of and attitudes toward nutrition. This questionnaire will take approximately 15 minutes for you to complete.

There are no known risks associated with this research. There are also no known benefits directly to you that would result from your participation in this research. However, results of this research may benefit students in the future.

We will do everything we can to protect your privacy. Please do not place your name or other identifying information on the questionnaire. This will ensure that once the questionnaire is completed we will be unable to specifically link data to an individual.

Your participation in this research study is voluntary. You may choose not to participate and you may withdraw your consent to participate at any time. You will not be penalized in any way should you decide not to participate or to withdraw from this study.

Contact information

If you have any questions or concerns about this study or if any problems arise, please contact Dr. Beth Kunkel at Clemson University at 864-656-5690. If you have any questions or concerns about your rights as a research participant, please contact the Clemson University Institutional Review Board at 864.656.6460.

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