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# Nutrient intake in college students in a Midwestern regional university compared to the recommended dietary guidelines

Rukmini Sen

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Nutrient Intake in College Students in a Midwestern Regional University  
Compared to the Recommended Dietary Guidelines

By

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Thesis

Submitted to the School of Health Sciences

Eastern Michigan University

In partial fulfillment of the requirements for the degree of

MASTER OF SCIENCE

In

Human Nutrition

Thesis Committee:

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November 15, 2007

Ypsilanti, Michigan

NUTRIENT INTAKES IN COLLEGE STUDENTS IN A MIDWESTERN  
REGIONAL UNIVERSITY COMPARED TO THE RECOMMENDED DIETARY  
GUIDELINES

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## DEDICATION

This thesis is dedicated to my grandmother, Mrs. Sumitra Sen; father, Mr. Aroop Sen; mother, Dr. Indrani Sen; and aunt, Ms Srabani Sen, who have supported me all the way throughout the course of this thesis.

This thesis is also dedicated to my fiancé, Mr. Gaurav Bankar, who has been a great source of motivation and inspiration and has taught me that even the largest task can be accomplished if it is done one step at a time.

This thesis is dedicated to my uncle and aunt, Dr. Nitis Sarkar and Mrs. Chandana Sarkar, for their unconditional love and support.

Finally, this thesis is dedicated to all those who believe in the saying that “He who has health, has hope. And he who has hope, has everything.”

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## Abstract

The prevalence of obesity is problematic in the United States. The objectives of the present study were to determine the extent of obesity in students studying at Eastern Michigan University and to evaluate their diet quality. Body Mass Index (BMI) of students (19-30 years, n=100) was measured from self-reported heights and weights as a benchmark of their weight category. Intakes of total energy (kilocalories), macronutrients and key micronutrients were assessed from three-day food diaries maintained by participants and compared with the Dietary Reference Intake Standards. Results indicated that 4% of EMU students were underweight, 52% were within a normal weight range, 28% were overweight, and 16% were obese. No linear relationships existed between BMI and energy intake. Consumption of most nutrients, except sodium were within the Recommended Dietary Guidelines. Since 44% of students at EMU are overweight or obese, a health promotion campaign aimed at weight control is warranted.

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## Chapter I – Introduction

Improved nutrition has been a cornerstone upon which society builds its economy and plans its future. Adequate nutrition plays an important role to help the nation and its people to pursue goals that improve the human condition. The relationship between diet and health is widely accepted. A well-balanced diet is essential to good health. Conversely, poor eating habits exact a heavy toll on society and play a significant role in a majority of deaths today. Currently, American diets are typically too high in calories and fats and too low in fruits and vegetables—problems associated with certain chronic diseases and obesity. A century ago, nutritional problems centered on inadequate intake of certain vitamins and minerals, resulting in nutritional deficiencies such as rickets, scurvy, and beriberi. Now, nutritional problems in America are driven by the discovery of strong links between nutrition and chronic diseases such as coronary heart disease, cancer, and stroke (United States Department of Agriculture).

It has been a great concern of health educators whether college students practice diet and health behaviors that follow the 2005 dietary guidelines for Americans. The 1995 National College Health Risk Behavior Survey found that the majority of college students did not eat the recommended amounts of nutrients per day and had eaten 3 or more high-fat foods daily, leading to obesity (National College Health Risk Behavior Survey, 1997).

According to the American College Counseling Association, one of the greatest challenges a student faces when entering higher education is the adjustment to an unfamiliar environment (American College Counseling

Association). Indeed, nationally one of the most frequently cited reasons for leaving an institution after the first year of study is the lack of fit between the student's expectations and background and what was encountered during the first year. The concept of fit covers all aspects of life, including food choices. Prior to entering college, many students are used to having regular meal times: breakfast before the school day, lunch during school, and dinner at night. This structure does not always apply to a college student's schedule or lifestyle. Often, students do not think to schedule meals into their day. Since the "regular" meal routine is no longer naturally integrated into their life, eating routines may suffer (American College Counseling Association).

The college environment may exacerbate the psychological, biological, and socio-cultural causes for the development of faulty eating patterns or, in extreme cases, an eating disorder. Students faced with new independence as well as separation from home and family can struggle with finding their balance. This transition can be hard, and the feelings created by stress can then be projected on one's body, thus creating a challenging relationship with food and body image (American College Counseling Association).

Studying weight gain among college students is more than an academic exercise. It points to another potential battleground in the fight against obesity that plagues our nation. Institutions have the responsibility to provide knowledge, attitudes, and examples of behaviors among students that will promote healthy weight, intellectual development, and overall quality of life, today and in the future. Body weight is dependent on a balance between energy taken in and

expended. It is important that we have a clear understanding of calories and nutrients consumed by students.

Hence, the main goal of this study was to determine the food intake of college students and compare it with the current recommended dietary guidelines for Americans.

## Chapter II – Literature Review

The following research studies have been done to determine what college students consume, their eating patterns, and their knowledge and awareness of the relationship between diet and health. However, more research needs to be done to understand the current food consumption correctly.

### *Current Eating Trends of College Students in USA*

The 2005 Dietary Guidelines for Americans recommends that the Food Guide Pyramid should guide food choices and emphasizes a variety of grains, especially whole grains, and a variety of fruits and vegetables to form the base for healthy eating. Further recommendations include food choices low in saturated fat and cholesterol and moderate in total fat, beverages and foods that limit intake of sugars, and foods with less salt (United States Department of Agriculture, 2001-2002).

Researchers examined food consumption of Americans from the data provided by the United States Department of Agriculture (USDA). The aggregate food supply in 2000 provided 3,800 calories per person per day, which was 500 calories above what was consumed in 1970 and 800 calories above what was consumed in 1957 and 1958 (Buzby, Wells, & Vocke, 2006).

While studying the consumption of the major food groups to determine the transition of food consumption patterns over a period of 30 years, it was found that even if there was a rise in the consumption of vegetables and fruits, it was still below recommended amounts of 5 servings per day and includes little

variety, which might result in significant vitamin and mineral deficiencies.

Average meat consumption showed a marked increase where, even if the intake of red meat was evident, an increase in the use of chicken and fish was also evident. The per capita grain use including rice, wheat corn, and barley products have increased, and consumption of cakes, cookies, pastries, and pies was predominant. Dairy and calcium-rich food consumption was half of the recommended amount (2-3 servings), but there was an increase in cheese consumption, with it, at its peak in the year 2000, accounting for more than two fifths (76%) of total daily dairy servings. The consumption of unhealthy fats and sugars was also noted (United States Department of Agriculture, 2001-2002).

A health study involving 1,800 students conducted at Tufts University in Medford, Massachusetts (2002), revealed that most students don't gain the much-ballyhooed "freshman 15," but college men gained an average of 5.5 pounds their freshman year, and college women gained an average 4.5 pounds (Hellmich, 2002). Sixty-six percent of freshmen did not consume five servings of fruits and vegetables recommended in a day. Fifty percent of students did not get the recommended 25 grams of fiber a day. Sixty percent consumed diets high in saturated fat. Thirty percent of women did not get enough calcium. Fifty-nine percent were aware of the fact that their diet had gone downhill since they went to college. Thirty-two percent of students reported a decline in their body image during their freshman year. Forty percent of normal weight college women perceived that they were overweight. Forty-one percent reported a decline in their overall feeling of happiness during their freshman year. These results were

significant because eating habits that men and women develop during their college years often follow them into their 30s (Hellmich, 2002).

A study was designed in 2005 by Racette et al. in Washington University in St Louis, Missouri, to assess weight, exercise, and dietary patterns of 764 college students (53% women, 47% men) during freshman and sophomore years (Racette, & Deusinger, et al., 2005). Students had their weight and height measured and completed questionnaires about their recent dietary patterns and exercise. It was seen that at the beginning of freshman year, 70% ate fewer than 5 fruits and vegetables daily, and more than 50% ate fried or high-fat fast foods at least 3 times during the previous week. Twenty-nine percent of students reported not exercising. By the end of their sophomore year, 70% of the 290 students who were reassessed had gained weight (4.1+/-3.6 kg). However, there was no apparent correlation with exercise or dietary patterns (Racette, & Deusinger, et al., 2005).

Another study was conducted in 2006 on positive and negative trends in university students' food intake with 1257 men and 2160 women with the mean age of 22.4 +/- 1.3 to evaluate the food intake and its trends in university students. The study design included 24-hour recall and frequency questionnaires. Meat consumption was found to be quantitatively sufficient; intakes of milk, fruit, and vegetables insufficient. In contrast, cereal products intake was excessive. Men ate more meat, milk, eggs, cereals, and fat than women, and women ate more fruit, vegetables and sugar than men. The study

suggested that students' food consumption has not been in agreement with recommended dietary allowances (Stefanikova, & Sevcikova, et al., 2006).

*The fast food fever.* Grabbing a meal on the run is a common part of the daily routine in college students. The average American eats out about 4 times weekly and frequently at fast food restaurants. College students have been reported to eat meals at fast food restaurants 6 to 8 times weekly. Hence, foods eaten at fast-food restaurants do substantially contribute to the nutrient intakes of individuals in the United States, especially college students (Driskell, Kim, & Goebel, 2005).

A cross-sectional study (2003) was designed to examine the dietary profile associated with fast food use. A comparison was made on the dietary intake of 17,370 adults and children on the day that they ate fast food with the day that fast food was not eaten, and the data were collected by 2 non-consecutive 24-hour dietary recalls. The results revealed that 37% of adults and 42% of children reported fast food use. Participants who reported eating fast food had a higher intake of energy, fat, saturated fat, sodium and, carbonated soft drinks, and lower intake of vitamins A and C, milk, fruits, and vegetables than those who did not report eating fast food. It was concluded that consumers should be aware that consumption of high fat fast food might contribute to higher energy and fat intake and lower intake of healthful nutrients (Paeratakul, Ferdinand, & Champagne, et al., 2003)

In 2004 another study by USDA looked at the impact of energy and nutrient intakes and overweight status. This study grouped participants (ages 20

years and older) according to their fast food intake and compared their diet quality and overweight status. Three separate analyses were conducted: The first one was the effect of fast food on diet quality of males and females based on day-one data. Second was the comparison of dietary and overweight status of adults who ate fast food on one, two, or none of survey days, and, finally, within-person analysis comparing the energy and macronutrient intakes of adults who ate fast food on one of the two survey days. The results revealed that at least one in four adults reported eating fast food during the survey period. The diet of individuals who consumed fast food was high in energy and energy density. Fast food provided more than one third of the day's energy, total fat, and saturated fat. Substantially large amounts of non-diet carbonated soft drinks were reported consumed at fast food places, but milk and fruits were not. Adults who reported eating fast food on at least one survey day had higher mean body mass index values than those who did not eat fast food on both survey days. The study also showed a small but significant positive association between fast food consumption and overweight status (Bowman, & Vinyard, 2004).

#### *Impact of Gender Difference in Making Food Choices*

A better understanding of the influence of gender on the eating habits of college students is needed as studies have suggested that, most likely, differences exist (Huang, Song, & Schemmel, et al., 1994). Information is not available as to whether the reasons that men eat at fast-food restaurants are different from those of women. College men have been reported to consume more high-energy and high-fat foods than women. The recommendations for

food energy and for many of the essential nutrients are different for men and women (Huang, Song, & Schemmel, et al., 1994).

A study (University of Nebraska, Lincoln, NE, 2006) was conducted on 113 men and 113 women to determine gender differences in fast-food restaurant eating habits of a group of college students at a large Midwestern land-grant university. A 2-page questionnaire was developed, which assessed the participant's frequency of eating meals and snacks at fast-food restaurants and the factors influencing food choices at fast-food restaurants. It was seen that a significantly higher percentage of men (84%) than women (58%) reported typically eating fast foods for lunch at least once weekly and a significantly higher percentage of men (70%) than women (63%) reported typically eating at American burger/fries establishments at least once weekly. About 41% of men and 21% women typically ordered carbonated soda, whereas the reverse was reported for carbonated diet soda (14% versus 31%). Thirty-seven percent of women, compared to 13% of men gave eating with family/friends as one of two main reasons for eating at fast food restaurants. More men (44%) reported typically finishing what has been ordered at fast-food restaurants, whereas more women (40%) typically ate until satisfied. Fifty percent of men reported not typically considering portion sizes, and 50% of women reported typically considering small portion sizes. Thirty percent of men and 51% of women reported sometimes choosing menu options they considered healthier at fast-food restaurants. The study revealed that gender differences exist in fast food

restaurant eating behaviors of this group of college students (Judy, Driskell, & Meckna, et al., 2006).

A similar study was done to investigate the influence of gender on dietary trends, eating habits, and nutrition self-assessment and beliefs of a group of college students at a large Midwestern university. One hundred and five male and one hundred and eighty one female undergraduate students completed a questionnaire where height, weight, and body mass index were studied. Higher percentages of women than men tried a low-fat and a low-carbohydrate diet, and fewer women than men had never tried a diet. Significantly higher percentages of women than men agreed that they had too much sugar in their diets, felt it was important to limit carbohydrate and fat consumption to lose weight, and felt they needed to lose weight. Ninety-four percent of participants agreed that it is important to eat a variety of foods for good health. It was also observed that gender differences existed in these college students with regard to anthropometrics, choices of diets, nutrition knowledge, and beliefs (Davy, Benes, & Driskell, 2006).

In order to assess the role of gender differences and racial similarities in both food and life and pleasure and worry, researchers at the University of Pennsylvania conducted a study in 2003 with questionnaires on food attitudes and behaviors, which were completed by 2,200 American undergraduates from 6 regionally dispersed college campuses. Results indicated that more women and a comparatively lower number of men had major concerns about eating and food with respect to both weight and health. A 6-factor structure that emerged from the

study were weight concern, diet and health orientation, beliefs about the diet-health link, food negativity/importance of food as a source of pleasure in life, eating disordered behaviors, and natural/vegetarian food preferences. The study revealed few regional differences, but gender was the strongest predictor of eating and food with respect to both weight and health (Rozin, Bauer, & Catanese, 2003).

Another study was conducted in order to test the applicability of involvement on issues of obesity and eating habits. The researchers surveyed 358 college students at a state university in the western United States. They found food decisions to be of greater personal importance and relevance to female students than to their male counterparts (Levi, Chan, & Pence, 2006).

Food consumption patterns of college students, divided into subgroups of men (n= 58) and women with mean energy intakes greater than 1,200 kcal (n= 192) and women consuming less than 1,200 kcal (n= 53), were studied using 3-day food records. Patterns of nutrient intakes, eating frequency, and type of foods eaten differed among subgroups. Women with less than 1,200 kcal had lower intakes of protein, carbohydrate, fat, calcium, iron, thiamin, riboflavin, and niacin; they ate less frequently; and they ate less meat and eggs, legumes, bread, cooked starchy vegetables, milk products, desserts, added fat, and added sugar than did men and women whose mean energy intakes exceeded 1,200 kcal. There were differences between the latter two groups for 10 nutrients and for intakes of fluid milk, meat and eggs, legumes, bread, cooked starchy vegetables, alcoholic beverages, and noncarbonated, sweetened beverages.

Diets of men met the Recommended Dietary Allowances (RDA) for all nutrients calculated, and diets of women whose intakes exceeded 1,200 kcal met all RDAs except for iron. Group mean intakes of women with less than 1,200 kcal did not meet the RDAs for calcium, iron, thiamin, riboflavin, and niacin. However, the subgroup with intakes less than 1,200 kcal consumed food of greater nutrient density than did other college students (Hernon, Skinner, & Andrews et al., 1986).

Gender differences in food intake pattern of students have been studied worldwide. A study was conducted on 217 male and 177 female college students to compare eating attitudes and lifestyles of male and female college students in Beijing, China. The participants filled out an Eating Attitudes Test-26 (EAT-26) and a lifestyle questionnaire that revealed that five percent of male and six percent of female students were above the cutoff point on the EAT-26 for abnormal eating attitudes. Body perception of being fat (distorted body image) was the factor most associated with abnormal eating attitudes and weight related concerns, which were prevalent amongst Chinese students (Makino, Hashizume, & Tsuboi, et al., 2006).

Overweight and obesity are epidemic in the United States, particularly among minority populations. A cross-sectional survey was conducted among 392 predominantly African American students in the Mid-Atlantic region in the year 2003. Participants were on average 24 +/- 5 years of age and 69% female; more than 90% were identified as African American, or Black. Data were collected on weight, weight management activities, individual and familial weight history, and

health status indicators. Compared to National Institutes of Health guidelines, about 30% of males and 28% of females in this study were considered overweight, 12% of males and seven percent of females were considered obese, and seven percent of males and females were considered extremely obese. These data thus suggest that overweight is a significant problem in this population (Gary, Gross, & Browne, et al., 2006).

### *Significance of Body Mass Index*

Body Mass Index (BMI) is an indicator of body fatness for most people and is used to screen for weight categories that may lead to health problems. It is one of the widely used methods for population assessment of overweight and obesity. Body Mass Index is calculated from a person's weight and height by the following formulas:  $\text{weight (kg)} / \text{height (m)}^2$  for kilograms and meters/centimeters or  $\text{weight (lb)} / \text{height (in)}^2 \times 703$  for pounds and inches. For adults 20 years old and older, BMI is interpreted using standard weight status categories that are the same for all ages for both men and women. The categories are Underweight (below 18.5), Normal weight (18.5 – 24.9), Overweight (25.0 – 29.9) and Obese (30.0 and above) (Centers for Disease Control and Prevention).

A cross-sectional study was done in a large state university with 159 college students, mean age 19.9, to measure whole-grain intake in college students and determine the association of consumption of whole grains with BMI. Intakes of whole grains, refined grains, calories, and fiber from food records and BMI from height and weight measurements were determined. Results indicated

that average intake of cereal grains was 5.4 servings per day, of which whole-grain intake accounted for an average of 0.7 servings per day. Whole-grain intake was significantly higher in normal weight students than in overweight and obese students (based on BMI). It was thus concluded that low intake of whole grains in this population of college students indicated the need for interventions aiming to increase whole-grain intake to the recommended minimum of 3 servings per day. College students who were concerned about their body weight may be motivated to increase their intake of whole-grain foods; however, their intake of whole grains is likely to be influenced by the availability of these food items in campus dining halls and other locations around the college campus (Rose, Hosig, & Davy, et al., 2007).

Another study was done by the Department of Health Promotion and Kinesiology, University of North Carolina at Charlotte (2001), using a questionnaire to assess nutritional intake, weight status, and dietary practices among 630 U.S. college students. Body mass index (BMI) was calculated using self-reported heights and weights, and nutritional status was assessed via 24-hour recall. Sixty-four percent of students had acceptable BMI levels (between 19 and 25), 16% of African-American females and 15% of African-American males had BMIs of 30 or above, indicating obesity. Approximately 18% of students consumed 5 servings per day of fruits and vegetables, seven percent consumed 6 or more grain products, and 53% consumed 2 or more dairy products. Twenty-seven percent reported never/rarely eating fast foods. The study recommended that culturally appropriate health education/promotion programs in colleges will

benefit in meeting Healthy People 2010 objectives (Debate, Topping, & Sargent, 2001).

A study was conducted by the Department of Health and Wellness, Arizona State University (2007), with 18- to 31-year-old students to measure change in BMI. The researchers obtained predictor variables from a Health Risk Appraisal which included clinical and medical history, medical usage, medications, pain or chronic conditions, perceptual measures, and behavioral factors. The results revealed that the predictor variables mentioned above were significant for men. Women in the increased BMI group were more likely to consume alcohol, use maladaptive coping behaviors, eat foods low in fiber, and consume caffeine; they were less likely to be stress-free, to eat cruciferous vegetables, and to refrain from eating high-cholesterol foods. However, the lack of research and interventions for reducing weight gain among college students warrants more research (Adams, & Rini, 2007).

In another study, researchers at the Human Nutrition Research Center on Aging at Tufts University, Boston, Massachusetts, surveyed 738 college students aged 18 to 27 years to assess overweight, obesity, dietary habits, and physical activity. They used BMI to estimate overweight and obesity. The study indicated overweight rates of 22% and obesity rates of five percent. More than 69% of participants reported consuming < 5 servings of fruits and vegetables per day, and more than 67% reported ingesting < 20 g of fiber per day; participants reported physical activity on fewer than 3 d/wk. Most college students were not meeting dietary and physical activity guidelines, suggesting the need for

prevention interventions and increased understanding of overweight in college students (Huang, Harris, & Lee, et al., 2003).

Another study was done in Texas A & M University (2001) where the diet, exercise, and health habits of 60 female students in a college were summarized. Heights and weights were used to calculate body mass index (BMI), and physical activity was measured using the Self-Reported Physical Activity scale. A three-day food record was used to estimate food and nutrient intake. The study reported that diets were nutritionally adequate but exceeded national recommendations for fat, sugar, and sodium, and their reports of exercise habits suggested that the lifestyles of 66% of the respondents were sedentary. Although the students' mean BMI's suggested healthy weights, 25% of the women were classified as overweight. A majority of the participants were following at least 1 of the 7 dietary guidelines; however, no participant was adhering to all proposed behaviors (Anding, Suminski, & Boss, 2001).

Another study conducted on 185 female college students aged 18 to 24 years measured their height, weight, waist, hip circumferences, and skin-fold thickness to assess body composition. Surveys included a dieting practices questionnaire and a 30-day physical activity recall. Participants were classified according to body mass index (BMI) as normal weight (n = 113), overweight (n = 35), or obese (n = 21). Outcomes of this study indicated that 83% of the participants used dieting for weight loss and believed they would be two percent to six percent greater than current weight if they did not diet; normal weight, overweight, and obese groups perceived attractive weight to be 94%, 85%, and

74%, respectively, of current weight. Eighty percent of participants reported using physical activity to control weight, although only 19% exercised at a level that would promote weight loss (Malinauskas, Raedeke, & Aeby, et al., 2006).

Collectively, results suggested that college students, regardless of weight status, would benefit from awareness programs to practice healthy and effective dieting practices to achieve or maintain a healthy body weight (Malinauskas, Raedeke, & Aeby, et al., 2006). Some of the recent developments show that some positive changes also are happening in food consumption, which can be interpreted to mean that some college students are aware of the negative consequences of faulty food habits and are changing their nutrient intakes (Hertzler, & Frary, 1989).

To identify the patterns of food usage, changes in food habits, and previous nutrition background, about 212 undergraduate college students were surveyed near the completion of an introductory nutrition course. The results revealed that nearly 50% increased their use of milk and milk products and 40% their use of vegetables; 50% decreased fat and sugar, and one-third decreased salt and calories. About half the class used nutrient supplements before the course started as well as at the time of the survey. Although about half of the students had received some pre-college nutrition information, this factor had no relationship to eating habits (Hertzler, & Frary, 1989).

However, another cross-sectional study was conducted by the Department of Community Development and Applied Economics, University of Vermont, on 200 college students enrolled in university dining plans. An Internet-based survey

was used to identify how closely respondents followed the Dietary Guidelines for Americans 2005, and whether their eating patterns were related to their knowledge of dietary guidance. It was observed that, for fruit, dairy, protein, and whole grains, increased knowledge was related to increased likelihood of meeting dietary guidelines. Moreover, when asked about individual food choices, nutrition knowledge was related to making more healthful choices in every case. Increased knowledge of dietary guidance appeared to be positively related to more healthful eating patterns, which suggested that guidelines such as the Dietary Guidelines for Americans 2005, in conjunction with effective public-awareness campaigns, may be a useful mechanism for promoting change in what foods consumers choose to eat (Kolodinsky, Harvey-Berino, & Berlin, et al. 2007).

#### *Possible Reasons for Increased Obesity Rates*

One of the hardest things about eating a healthy diet is keeping portions under control. As portion sizes grow, people tend to eat more quite often, which is greater than what they need, to stay healthy. Larger food portions have more calories, and consuming more calories than one requires leads to weight gain (American Obesity Association).

A quasi-experimental study was done with the primary objective to evaluate the characteristics surrounding college students' perception of typical portions of real food items. The study used independent repeated measures of food form (amorphous, solid, liquid), food macronutrient content (low

carbohydrate, high carbohydrate, low fat, high fat), and food-energy density (low, high), as well as one independent participants variable of sex (male, female). The main dependent measure was self-selected portion size representing what each participant felt was their typical portion of 15 food/beverage items. In addition, BMI was treated as a continuous predictor variable in regressions for portion-size estimation. The study revealed that participants (n=51) chose substantially larger portion sizes than reference portion sizes in 10 of the 15 food/beverage items. BMI positively predicted self-selected portion size for six of 15 food/beverage items. It was also seen that participants chose significantly larger portion sizes for high-carbohydrate foods than high-fat foods. The study concluded that a strong relationship exists between BMI and large portion sizes for high-energy-density foods, snacks, and high-carbohydrate foods (Burger, Kern, & Coleman, 2007).

In another study with fifty-one college-going men and women, researchers examined the effect of portion size on intake during a single meal and also investigated whether the response to portion size depended on which person, the participant or the experimenter, determined the amount of food on the plate. The participants were served lunch 1 d/wk for 4 wk, which included an entrée of macaroni and cheese consumed ad libitum. The results revealed that the portion size significantly influenced energy intake at lunch and the participants consumed 30% more energy (676 kJ) when offered the largest portion than when offered the smallest portion. This led to a conclusion that portion size is a modifiable

determinant of energy intake that should be addressed in connection with the prevention and treatment of obesity (Rolls, Morris, & Roe, 2002).

#### *Aftermath of Faulty Nutrient Intakes*

Environment and changes in behavior brought about by economic development, modernization, and urbanization have been linked to the rise in global obesity. Obesity poses a major risk for chronic diseases, including type 2 diabetes, cardiovascular disease, hypertension, stroke, sleep apnea, and certain forms of cancer. Diabetes, hypertension, and other obesity-related chronic diseases that are prevalent among adults have now become more common in youngsters. Poor dietary habits and inactivity are reported to contribute to the increase of obesity in youth (American Obesity Association).

The U.S. Department of Health and Human Services (HHS) set a national goal aiming to reduce adult obesity levels to 15 % in every state by the year 2010 (F as in Fat: How Obesity Policies are Falling in America).

#### *Recommended Standard Guidelines Provided for Nutrient Consumption*

The U.S. Department of Agriculture has been issuing dietary recommendations for more than 100 years. As the research base underlying these recommendations has expanded considerably over the years, dietary recommendations have evolved to keep pace with both the new findings and the changing patterns in food consumption and activity of the population. In spite of these changes, many of today's dietary recommendations remain impressively

similar to those of yesterday (Davis, & Saltos). The recommended standards that are available today are Dietary Guidelines for Americans; My Food Guide Pyramid; Dietary Reference Intake (DRI) and Acceptable Macronutrient Distribution Range (AMDR).

The Dietary Guidelines for Americans are mandated to be published jointly every 5 years since 1980 by the Department of Health and Human Services (HHS) and the Department of Agriculture (USDA). The most current one is the science-based guidelines from the federal government, The Dietary Guidelines for Americans 2005, which provides authoritative advice for people two years and older about how good dietary habits can promote health and reduce risk for major chronic diseases. The Guidelines serve as the basis for Federal food and nutrition education programs. They emphasize consumption of fruits, vegetables, whole grains, and fat-free or low-fat milk and milk products. These Guidelines recommend intake of lean meats, poultry, fish, beans, eggs, and nuts; and a diet low in saturated fats, trans fats, cholesterol, salt (sodium), and added sugars. The Dietary Guidelines offer basic information for eating a healthy diet and being physically active, learning how to make smart choices from every food group, finding your balance between food and physical activity, and getting the most nutrition out of your calories (United States Department of Agriculture).

My Food Guide Pyramid, developed by the USDA, offers a personal eating plan with the foods and amounts that are right for Americans. The older food guide pyramid was introduced in 1992. Then, a new and improved pyramid was created by the USDA that incorporated some exciting new dimensions and

features, "My Pyramid: Steps to a Healthier You" in 2005. The food guide pyramid also provides a detailed assessment of one's food intake and physical activity level. This resource helps the consumers to make smart choices from every food group, find balance between food and physical activity, and get the most nutrition out of the calories and learning to stay within the daily calorie needs. My Pyramid food patterns are designed for the general public ages 2 and over. They are not therapeutic diets for specific health conditions, so those with a chronic health condition should consult with a health care provider to find a dietary plan that is right for them (My Pyramid.gov).

Dietary Reference Intakes (DRI) is a system of nutrition recommendations from the Institute of Medicine (IOM) of the US National Academy of Sciences. The DRI system is used by both the United States and Canada and is intended for the general public and health professionals. For many years the National Research Council of the United States National Academy of Sciences has taken responsibility for establishing guidelines on what quantities of the various nutrients should be eaten by human males and females at various ages. These were called RDAs for Recommended Dietary Allowances, and often referred to as Recommended Daily Allowances (US Department of Health and Human Services). In 1941, President Franklin Roosevelt called the National Nutrition Conference for Defense (National Nutrition Conference for Defense, 1941), memorable for the release of the first set of RDAs by the Food and Nutrition Board of the National Academy of Sciences. It is the average daily dietary intake level that is sufficient to meet the nutrient requirement of nearly all (97 to 98%)

healthy individuals in a particular life-stage and gender group. These RDAs listed specific recommended intakes for calories and nine essential nutrients like protein, iron, calcium, vitamins A and D, thiamin, riboflavin, niacin, and vitamin C. Tolerable upper intake levels (ULs) are used to caution against excessive intake of nutrients (like vitamin D) that can be harmful in large amounts (US Department of Health and Human Services, Acceptable Macronutrient Distribution Ranges).

The current DRI recommendation includes Estimated Average Requirements (EAR), expected to satisfy the needs of 50% of the people in that age group. The Reference Daily Intake (RDI) is the value established by the Food and Drug Administration (FDA) for use in nutrition labeling. It was based initially on the highest 1968 Recommended Dietary Allowance (RDA) for each nutrient, to assure that needs were met for all age groups. It is the daily dietary intake level of a nutrient considered sufficient to meet the requirements of nearly all (97–98%) healthy individuals in each life-stage and gender group. Adequate Intake (AI) is the recommended intake where no RDI has been established, but the amount established is somewhat less firmly believed to be adequate for everyone in the demographic group (F as in Fat: How Obesity Policies are Falling in America).

Acceptable Macronutrient Distribution Range (AMDR) is defined as a range of intakes for a particular energy source that is associated with reduced risk of chronic disease while providing adequate intakes of essential nutrients. An AMDR is expressed as a percentage of total energy intakes. If an individual consumes below or above this range, there is a potential for increasing the risk of

chronic diseases shown to affect long-term health, as well as increasing the risk of insufficient intakes of essential nutrients. AMDRs have been established for protein, carbohydrate, fat, and linoleic (n-6) and alpha-linolenic (n-3) polyunsaturated fatty acids (US Department of Health and Human Services, Acceptable Macronutrient Distribution Ranges).

*The Current National and Regional Data on Overweight and Obesity*

The number of overweight and obese Americans has continued to increase since 1980, a trend that is not slowing down. Each year, obesity causes at least 300,000 excess deaths in the U.S., and healthcare costs of American adults with obesity amount to approximately \$100 billion (Physical Activity and Good Nutrition: Essential Elements to Prevent Chronic Diseases and Obesity, Centers for Disease Control and Prevention, 2007).

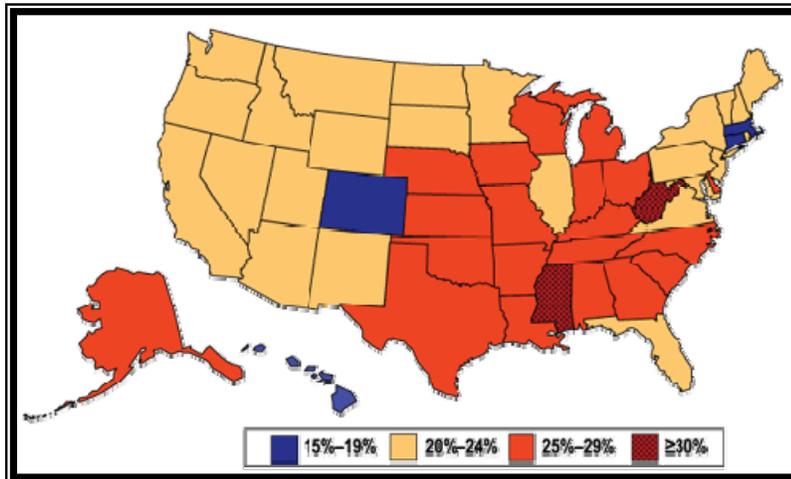


Figure 1. CDC's annual Obesity Trends, 2007

Source: Behavioral Risk Factor Surveillance System, CDC.  
 In states depicted in color blue, 15% to 19% of the population is obese. The states coded in beige indicate an obesity rate of 20% to 24%. The ones coded in orange and maroon depicts rates of prevalence of obesity of 25% to 29% and more than 30% respectively.

Figure 1 shows the prevalence of obesity in The United States of America in the year 2007. Centers for Disease Control and Prevention (CDC) are the nation's premier public health agency working to ensure healthy people in a healthy world. As per the Behavioral Risk Factor Surveillance System (BRFSS), the world's largest, ongoing telephone health survey system, tracking health conditions and risk behaviors in the United States in 2006, obesity rates continued to rise in 31 states. Currently in nineteen states including Michigan, more than a quarter of the population is classified as obese (Physical Activity and Good Nutrition: Essential Elements to Prevent Chronic Diseases and Obesity, Centers for Disease Control and Prevention).

The American College Health Association-National College Health Assessment (ACHA-NCHA) is a nationally recognized research survey that

collects precise data about the college students' health habits, behaviors, and perceptions. The BMI distribution trend was determined for among three consecutive years from 2004 (females: 58%, males: 37%) to 2006 (females: 64%, males: 33%) (The Premiere Student Health survey. American College Health Association – National College Health Assessment).

In Michigan in the year 2000, 39% of the population was overweight and 22% of the population was obese. A year later, 35% of the population was overweight and 25% of the population was obese. In 2002 37% was overweight and 25% was obese. The most recent study, conducted in 2007, reported an obesity rate of 25 to 29% (Kaiser Family Foundation State Health Facts Online, Overweight and Obesity Rate, 2005).

In Washtenaw County BMI, between the years of 1995 and 2000, the percent of overweight adults increased from 44% to 49%. The upsurge was most dramatic for men, where a 50% increase in obesity was seen (eWashtenaw).

#### *Nutrition Services Available at Eastern Michigan University (EMU)*

The Eastern Michigan University Office of Nutrition Services (ONS) offers Nutrition education and awareness programs for students and staff. The office is easily accessible and provides services for nominal charges. The services include nutrition counseling, nutrient analysis, and body fat analysis by bioelectrical impedance analysis (BIA). Computrition software is utilized for nutrient analysis. The software has the ability to search a database for a specific food and examine its nutrient composition. The average and total nutrient intake

can be computed over any given period of days. Nutrition counseling is an ongoing process in which a health professional, usually a registered dietitian (RD), works with students to assess their usual dietary intake and identify areas where change is needed. The RD's provide individual nutrition counseling where nutrition information, educational materials, support, and follow-up is provided to help the students make and maintain the needed dietary changes. EMU students are informed at the beginning of their college career during orientation about the health services offered by the institution.

### *The Research Statement*

Dietary knowledge, beliefs, and behaviors that are developed and exhibited during adolescence and college may carry over to adulthood and strongly influence future health status. The literature review indicates that overweight and obesity is posing a threat to the health of college students today, and faulty food habits may be one of the main contributors for the upsurge in the rates of overweight and obesity.

In 2005, a study highlighting the first annual ranking of the rate of fatness that prevails in the Universities in America was published in a popular journal, Men's Fitness Magazine. It identified Eastern Michigan University as the seventh fattest university in America on the basis of a summary of individual's gender and anthropometric measurements; the total weight gained or lost since beginning of college; the amount of vigorous and leisurely physical activity students report participating in each week; the amount of fast food, alcohol, and cigarettes

students consume each week; time they spend doing sedentary activities, such as watching TV, playing video games, or surfing the Internet; their use of supplements; fitness goals; hours of sleep students typically get per night; and, finally, whether the campus community promotes physical activity or not (Men's Fitness Magazine, 2005).

Although this study was not in a peer-reviewed publication, it tended to reinforce the perception that students at EMU are overweight and obese compared to students at other universities.

Healthy People 2010 is a set of health objectives for the nation to achieve over the first decade of the new century. Health and Human Services and other federal agencies serve as coordinators for specific focus areas of Healthy People 2010. Its primary goal is to increase the quality and years of healthy life by helping individuals of all ages increase life expectancy and improve their quality of life and to eliminate health disparities among different segments of the population. One of the Healthy People 2010 objectives is to increase the proportion of college and university students who receive information on dietary practices that prevent disease (US Department of Health and Human Services. Healthy people 2010). Before this can be accomplished, it is important to determine what students are currently consuming. There remain gaps in the knowledge related to nutrient consumption of college students. A systematic evaluation of diet quantity and quality will allow dietitians and nutritionists to provide better counseling for students.

The specific aims of this study are as follows:

1] To use the Body Mass Index (BMI) as a benchmark or standard in order to classify whether Eastern Michigan University students are at a healthy weight or belong to underweight, overweight, and obese categories.

2] To evaluate trends in intakes of energy, macronutrients, and selected micronutrients and compare them with the current Recommended Dietary Guidelines.

## Chapter III – Research Design and Methodology

### *Population Sample and Subjects Investigated*

Eastern Michigan University is located in Ypsilanti, Michigan, and serves 24,000 students of all ages and walks of life from around the globe providing a diverse community environment. The ratio of female to male students in EMU is 2:1. The average age of an EMU undergraduate student is 24.5, and the average age of an EMU graduate student is 34.

Approval from the Human Subjects Review Committee (Appendix A) was obtained during the beginning of spring semester in May 2007. The Deans of the College of Business, Technology, Arts and Sciences, Education and Health and Human Services were contacted (letter attached in Appendix B) and asked to provide permission for recruiting students from their respective colleges. With their permission, the instructors of the classes from where the students were recruited were approached. Students were recruited randomly in the classrooms during regular class periods. Participation was voluntary, and no incentives were provided. Pregnant women were excluded from the study as their diet is expected to be different from a regular college student's diet, owing to additional nutrient requirements. The study sample was composed of hundred adults ranging from nineteen to thirty years. The number of female and male participants was sixty-four and thirty-six, respectively. Students living both on campus and off campus were recruited to participate in this study, irrespective of ethnicity and religion.

### *Study Design*

An informed consent form (Appendix C) was developed and provided to all the participants. This form was completed by the students prior to the actual study. The study used a basic questionnaire, which was attached to the informed consent form. The one page questionnaire (Appendix D) contained questions that dealt with self-reported anthropometrics like height and weight, age, gender, ethnicity, dietary intake patterns, usual eating place, and residence.

A small group of ten students was used to validate the questionnaire before the start of the study. This group was provided with the questionnaire and nutrient intake form (Appendix E) and the food record instruction sheet (Appendix F). Whether they were able to understand the questions and answer them appropriately was first assessed. Researchers concluded that the survey questionnaire and the food record form were self-explanatory and the participants did not have difficulties understanding the instructions. Providing examples in the instruction sheet was helpful as it was a good guide for them to record their food intake correctly.

The participant's names were not disclosed and special codes were used to track each questionnaire. Once the subjects agreed to participate by signing the informed consent form and completing the survey, they were sent the nutrient intake form with complete instructions. Examples were provided to improve the accuracy of self-reporting. Participants were asked to maintain a three-day food recall to document the details of their food intake as per the instructions provided. Participants were encouraged to specify the brand names of all foods consumed

wherever possible and to be as specific as possible with the portion sizes while recording all foods. The respondents returned their nutrient analysis forms to the Office of Nutrition Services (ONS) at Eastern Michigan University. The food intake was then entered into Computrition, nutrient analysis software and data on macronutrients and relevant vitamins and minerals was obtained.

### *Parameters Measured*

Height and weight, age, gender, ethnicity, usual eating place and residence were obtained from a one-page survey questionnaire.

Body Mass Index (BMI) values were calculated using the self-reported height and weight data according to the following formula: weight (kg) / height (m)<sup>2</sup>.

Documentation of three-day dietary recall was obtained from the participants recruited, and a detail of their food intake was entered into the software used in the Office of Nutrition Services. Intake of total energy, fat, saturated fatty acid, protein, carbohydrate, vitamin C, folate, calcium, sodium, and iron were determined. Values were compared to the Acceptable Macronutrient Distribution Ranges (AMDR) and Recommended Dietary Reference Intakes (DRI) developed by the Food and Nutrition Board (FNB) of The Institute of Medicine.

### *Data Analysis*

Overall BMI was calculated. Based on BMI values, students were classified as either underweight (BMI below 18.5), normal weight (BMI 18.5 - 24.9), overweight (BMI 25.0 – 29.9), or obese (BMI 30.0 and above). Correlation and regression assessed the linear relationship between BMI and energy intakes. The percentage of calories from carbohydrates, protein, and fat was calculated and compared with the AMDR. Finally, using a one sample t-test, individual nutrient intakes of female and male students were compared to their respective standard DRI's. A p value of 0.05 or less was used to determine statistical significance. Microsoft Excel and the SAS program were used for the overall statistical analysis.

## Chapter IV – Results and Discussion

The current study was carried out with 100 students from Eastern Michigan University of Ypsilanti, Michigan. About 150 survey questionnaires and nutrient intake forms were distributed, and 100 completed forms were returned. Hence the response rate was 67%.

### *Demographics*

Sixty-four females and thirty-six males participated in the study. The participants (n=100) ranged in age from 19 to 30 years old, with a mean age of  $24.1 \pm 3.3$  years. The mean age of females was  $23.6 \pm 3.3$  years and the mean age of the males was  $25.0 \pm 3.1$  years.

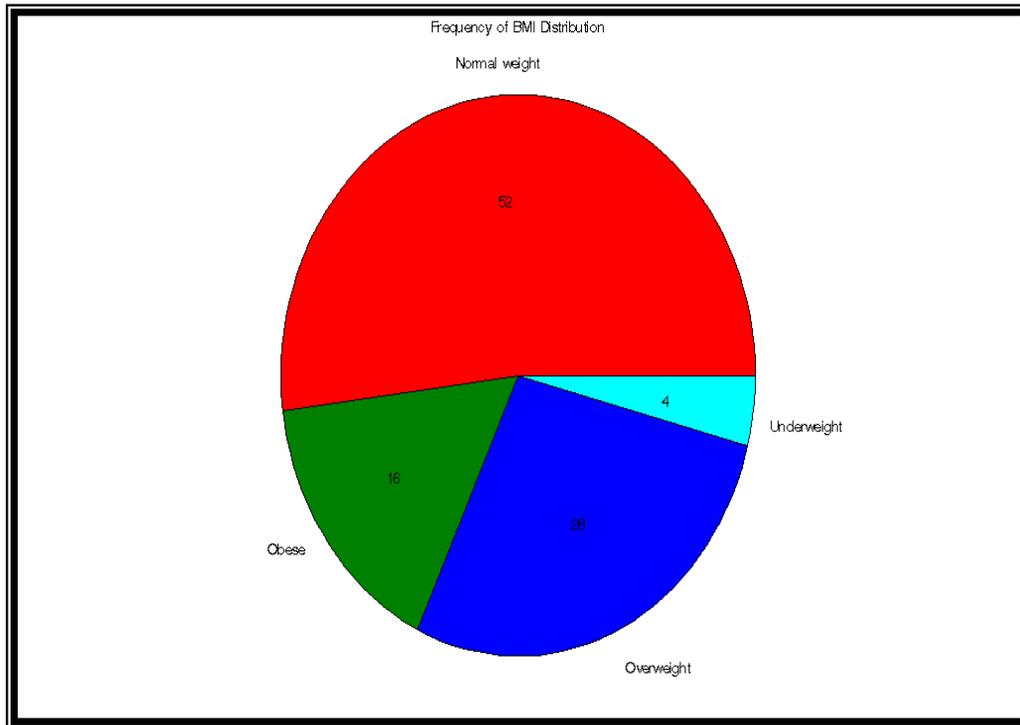
The mean weight of all participants was 72.2 kilograms ( $159.1 \text{ lbs} \pm 36.0$ ). The mean weight of females was 68 kilograms ( $148.7 \text{ lbs} \pm 28.4$ ), and the mean weight of males was 80.6 kilograms ( $177.5 \text{ pounds} \pm 38.5$ ).

The population in EMU is 68% Caucasian, 16% of African-American, three percent Asian and two percent Latino-American / Hispanic ethnic groups. In the present study, 84% of the participants were Caucasians, eight percent were African American, six percent were Asian and two percent were Latino.

### *Distribution of Body Mass Index*

BMI  $\text{weight (kg) / height (m)}^2$  was calculated from self-reported heights and weights. In this sample, the BMI ranged from 17.1 (underweight) to 35.9

(obese), and the mean BMI of this population was seen to fall marginally in the healthy weight category ( $25.0 \pm 4.4$ ).



*Figure 2.* BMI Distribution of Underweight (below 18.5), Healthy Weight (18.5 – 24.9), Overweight (25.0 – 29.9), and Obese (30.0 and above) students at Eastern Michigan University.

Four percent of EMU students were underweight, fifty two percent were normal weight, twenty eight percent were overweight, and sixteen percent were obese.

The above chart indicates the distribution of BMI among EMU students. It shows that four percent of the students were underweight, 52% of students were

of healthy weight, 28% of students were overweight, and 16% of students were obese.

Next, gender differences in BMI were determined. The average BMI for females (n=64) was  $24.6 \pm 4.4$  and for males (n=36) was  $25.7 \pm 4.5$ . On an average, the male student was slightly overweight whereas the female student was within healthy weight. Five percent of females were underweight and 55% were within a healthy weight range, 28% were overweight and 22% were obese. Three percent of males were underweight, 47% were within the healthy weight range, 28% were overweight and 13% were obese.

Table 1

*Average Body Mass Index of Male and Female Students at EMU*

Gender	BMI
Total Sample (n=100)	$25.0 \pm 4.5$
Female (n=64)	$24.6 \pm 4.4$
Male (n=36)	$25.7 \pm 4.5$

Values for BMI are expressed as mean  $\pm$  SD. The average BMI of females was 24.6, and that of males was 25.7.

*Comparative data on the trends in BMI categories.* The data on the findings of different studies were obtained and compared with the current study.

The data are collected from previous studies conducted by the American College Health Association – National College Health Assessment and EMU Health Services Survey.

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Table 2

*Comparison of Findings on the trends in BMI Categories of American College Health Association – National College Health Assessment surveys conducted from 2004-2006, EMU Health Services Survey (2005) and the Current study Data*

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BMI Categories	ACHA-NCHA National Data			EMU Health Services Survey	Current study findings (EMU)
	Fall 2004 %	Fall 2005 %	Fall 2006 %		
Underweight	5.0	4.1	5.0	4.2	4.0
Healthy weight	64.1	60.8	64.3	54.2	52.0
Overweight	21.8	23.4	20.9	25.3	28.0
Obese	6.1	7.6	6.5	10.5	16.0
Gender					
Females %	58.0	63.5	64.0	72.4	64.0
Males %	37.0	32.2	33.0	26.0	36.0

*Percentage of students who are underweight, healthy weight, overweight or obese nationally, in EMU health survey and the current study.*

The number of underweight students in the ACHA-NCHA study was reduced from five percent in 2004 to four percent in 2005. In 2006, again five percent of students were underweight. At EMU both data from the Health

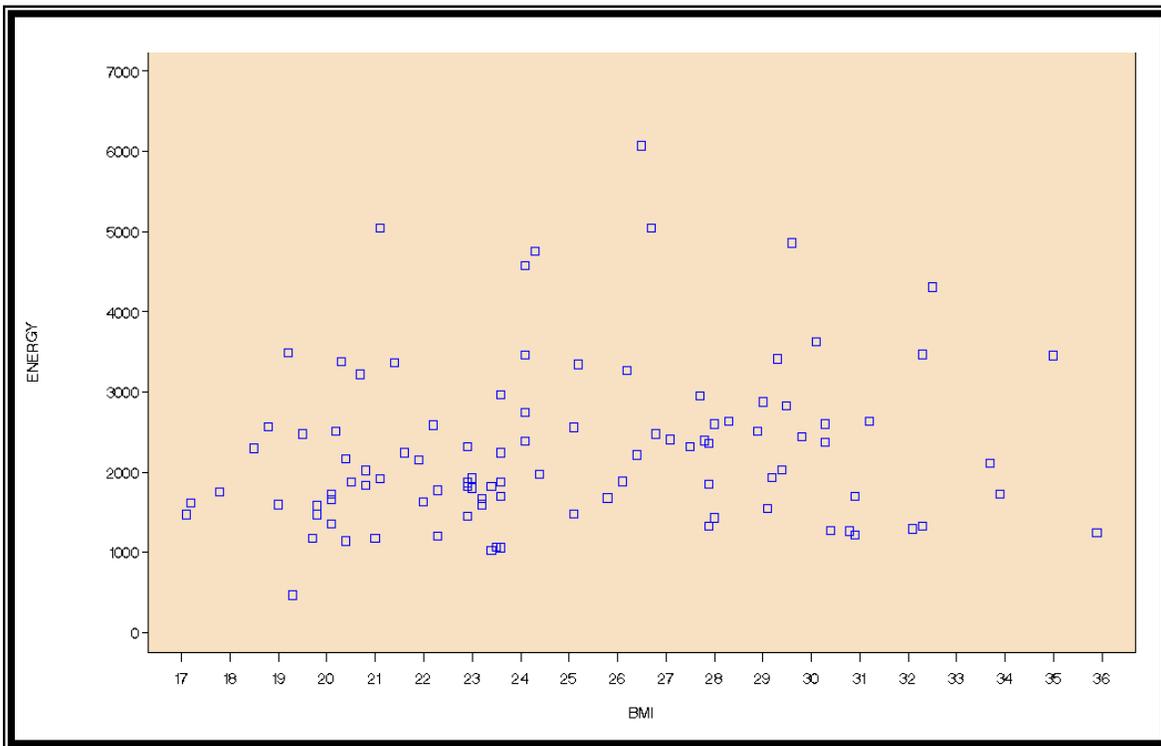
Service from 2005 and the current study determined that four percent of the students were underweight.

The number of students who were at a healthy weight as per the national ACHA-NCHA data was 64% in 2004 as well as in 2006. As per EMU Health Services, the data of healthy weight students was 54% and the data of the current study was 52%.

Nationwide, approximately 21% of students were overweight and seven percent of students were obese in 2006. In contrast, a larger percentage of students at EMU were overweight (25% in 2005 and 28% in 2007). Likewise, more (11% in 2005 and 16% in 2007) students at EMU were obese than their counterparts elsewhere.

#### *Relation Between Energy Intake and BMI*

Correlation and regression analysis was performed to analyze whether there is a relationship between the energy intake of the population studied and their Body Mass Index. Mean energy content for the participants is 2287 Kcal. A correlation coefficient of 0.16 was obtained, indicating that there was no significant correlation between energy intake and BMI. The results are depicted in Figure 3.



*Figure 3. Correlation and Regression between Energy Intake and BMI of EMU students.*

The Energy consumption in kilocalories was plotted on the X axis and BMI was plotted in the Y axis of the above figure. The scatter plot reveals no relationship between energy intake and BMI.

The results are depicted in a scatter plot in the above figure, which suggests that there is not a strong linear relationship between BMI and Energy intake.

*Comparison of Percentage of Calories from Different Macronutrients with the Recommended Values*

The Accepted Macronutrient Distribution Range (AMDR) suggests that 45-65 %, 10-35%, 20-35% and less than 10% of calories should be obtained from carbohydrates, proteins, fats, and saturated fats respectively. The percentage of total calories consumed by students at EMU derived from carbohydrates, proteins, fats, and saturated fats was thus calculated.

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Table 3

*Comparison of the percentage of calories from different Macronutrients Consumed by EMU Students with the Standard Recommended values (AMDR)*

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Nutrients	Standard % (AMDR)	Female Sample (n = 64) %	Male Sample (n = 36) %
Carbohydrate	45 – 65	47.3	46.6
Protein	10 – 35	15.9	16.0
Fat	20 – 35	36.4	38.1
SFA	< 10	10.2	8.5

The percentage of calories consumed from carbohydrates and proteins was within the acceptable range, whereas the percentage of fat that was consumed was higher than recommended levels. The saturated fatty acid consumption of females was higher than recommended values.

The above table indicates that calorie consumption from carbohydrates and proteins by both females and males was within the recommended range.

The percentage of fat, consumed by both female and male students, was slightly

higher than the recommended values. Saturated fats (SFA) consumed by the male population was within the recommended range, while females consumed slightly higher amounts of saturated fatty acids.

#### *Comparison of Intake of Different Nutrients with Recommended Values*

A one-sample t-test was used to compare different nutrient intakes of students with recommended values.

Even though carbohydrate and protein intakes have been compared with the Acceptable Macronutrient Distribution Range (AMDR), a more detailed comparison was done using the standard DRI since RDA values have been established for the above mentioned macronutrients. Since the standard values differ for males and females, the results were segregated by gender.

The comparison of nutrients with recommended values is depicted in Table 4.

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Table 4

*Comparison of Nutrient Intakes of Female Students at EMU with Recommended Values*

Nutrient	Recommended DRI	Nutrient consumption/day
Carbohydrate (gm)	130	243.7 ± 15.3 <sup>a</sup>
Protein (gm)	46	80.9 ± 4.0 <sup>a</sup>
Vitamin C (mg)	75	105.2 ± 5.1 <sup>b</sup>
Folacin (mcg)	400	355.5 ± 20.1
Sodium (mg)	1500	3738.8 ± 110.2 <sup>a</sup>
Calcium (mg)	1000	929.0 ± 43.3
Iron (mg)	18	18.0 ± 1.0

Daily nutrient consumption of carbohydrate (gm) protein (gm), vitamin C (mg), folacin (mcg), sodium (mg), calcium (mg) and iron (mg) of female students at EMU compared with the recommended values. Values represent mean ± SD. a = p<.0001, b = p<.01.

Consumption of calcium, folacin, and iron was within the recommended guidelines, whereas protein, carbohydrate, sodium, and Vitamin C consumption was significantly different from that of the recommended values. Female students consumed significantly more carbohydrates (p<.0001), protein (p<.0001), vitamin C (p<.01), and sodium (p<.0001) than recommended.

Similarly, a comparison was done to determine if the nutrient intake of males conformed to the recommended guidelines.

Table 5

*Comparison of Nutrient Intakes of Male Students at EMU with Recommended Values*

Nutrient	Recommended DRI	Nutrient Consumption/day
Carbohydrate (gm)	130	303.6 ± 20.5 <sup>a</sup>
Protein (gm)	56	115.3 ± 3.8 <sup>a</sup>
Vitamin C (mg)	90	104.4 ± 6.2
Folacin (mcg)	400	511.1 ± 22.1
Sodium (mg)	1500	3815.4 ± 114.3 <sup>a</sup>
Calcium (mg)	1000	1407.0 ± 16.3
Iron (mg)	8	22.8 ± 0.5 <sup>a</sup>

Daily nutrient consumption of carbohydrate (gm) protein (gm), vitamin C (mg), folacin (mcg), sodium (mg), calcium (mg) and iron (mg) of male students at EMU compared with the recommended values. Values represent mean ± SD. a = p<.0001.

Consumption of calcium, folacin, and vitamin C in male students was within the recommended guidelines, whereas consumption of carbohydrates (p<.0001), protein (p<.0001), sodium (p<.0001), and iron (p<.0001) was significantly above the recommended values.

## *Discussion*

Obesity and overweight have become concerns of great magnitude, and studies have defined obesity as the second most preventable cause of death. National survey data show an increase in mean BMI and in the prevalence of overweight and obesity for adults and children in the United States, indicating a change in the distribution of BMI.

Centers for Disease Control reported that the prevalence of overweight and obesity in the past 30 years has increased sharply for both adults and children. Between 1976–1980 and 2003–2004, the prevalence of obesity among adults aged 20–74 years increased from 15% to 33% (Physical Activity and Good Nutrition: Essential Elements to Prevent Chronic Diseases and Obesity, Centers for Disease Control and Prevention, 2007). Data for young adults between 19 to 30 years were not available separately to compare with this study.

Since this study was carried out in Eastern Michigan University, which is located in Washtenaw County in southeastern Michigan, it is important to discuss the trends in body fat distribution in both these regions. From 2000 to 2005, there has been a significant increase in rates of both overweight and obesity in Washtenaw County (Kaiser Family Foundation State Health Facts Online, Overweight and Obesity Rate, 2005). Data for young adults between 19 to 30 years was not available separately to compare with this study.

In Washtenaw County, between the years 1995 and 2000, the percent of overweight adults increased. The increase was most dramatic for men as their overweight rates were higher than women's (eWashtenaw). In this study, too,

44% of students were either overweight or obese. The American College Health Association-National College Health Assessment (ACHA-NCHA) monitors the health status of students every year. The findings of this study when compared to 2004, 2005, and 2006 studies by the American College Health Association-National College Health Assessment (ACHA-NCHA) showed that students who were underweight was similar to that found by (ACHA-NCHA). Data from the current study indicate that fewer students at EMU can be classified as being of healthy weight. Likewise, data collected by the EMU Health Services Survey in 2005 suggest that only 54% of students at EMU were of a healthy weight compared to 64% of students nationally. Furthermore, greater numbers of students at EMU were overweight or obese, compared to their counterparts nationally.

Dietary recall of students found that many skipped meals that were noted during daytime, and this was compensated by overeating during dinner and later hours. Snacking was a very common feature noted in the diet patterns. Night time snacks were generously consumed. Processed foods and take-out dinners were also seen in the food recall that included pizzas and frozen dinners on one hand and salads and cheese-free subways on the other.

Next, the nutrient intakes were compared to the standard Acceptable Macronutrient Distribution Range (AMDR) and Dietary Reference Intake (DRI) of the Institute of Medicine.

First, the three macronutrients – carbohydrate, protein, and fats – were compared with AMDR, and data indicated that students consumed carbohydrates

and proteins in accordance with the recommendations. The amount of fat ingested was a little above the standard values for both males and females, and saturated fats were consumed in excess of the recommended values by females. As evidenced by the three-day food recall, consumption of whole-milk dairy products, eggs, cookies, French fries were consumed copiously.

Next, the nutrient intakes were compared to the DRI standard values since they provide specific recommendations for the macronutrients and selected micronutrients. Specific carbohydrate consumption in both males and females was much above the recommended standard values. The food recall indicated that the consumption of breads was most common, followed by pasta and spaghetti. Ramen noodles were also a common quick and easy dinner. Even if majority of the students consumed whole grain products, the portion sizes they consumed had a big impact. Starchy carbohydrates from grains, potatoes, sweets, and other sugary foods were prominent in their diet. Excess carbohydrate gets converted, via insulin, into fat and gets stored in the adipose or fatty tissue (Horton, Drougas, & Brachey, et al., 1995). Studies also suggest that the increased prevalence of overweight and obesity in the United States is linked to an increase in carbohydrate intake, with no appreciable change in absolute intake of fat (Gaesser, 2007).

Similarly, protein intake in both males and females observed was much above the standard values. The food recall indicated that the consumption of luncheon meat and meat entrees was very common in the daily diet. For males, the protein shakes and drinks also contributed to the increase in protein

consumption. The influence of the Atkins diet, which promotes exclusion of many food groups, especially fruits and vegetables, perhaps contributed to increased intake of proteins among Americans. Excess protein consumption has harmful effects because the human body is unable to store extra protein. Protein consumed in excess of the body's needs is not used to build muscle; rather, such extra protein is converted to and stored as fat. Some potential effects of excess protein include dehydration and increase in the loss of urinary calcium (Massey, 1998). Considerable debate has taken place over the safety and validity of increased protein intakes for both weight control and muscle synthesis. Study suggests that dangers of excessive protein, defined as when protein constitutes more than 35% of total energy intakes, include hyperaminoacidemia, hyperammonemia, hyperinsulinemia, nausea, diarrhea, and even death (Bilsborough, & Mann, 2006). High protein intake may promote renal damage by chronically increasing glomerular pressure and hyperfiltration. Some studies suggest that while protein restriction may be appropriate for treatment of existing kidney disease, significant evidence for a detrimental effect of high protein intake on kidney function would require more research (Martin, Armstrong, & Rodriguez, 2005).

Vitamin C is an antioxidant that plays a protective role in the body and is required to build and maintain healthy skin, bones, and teeth and to heal wounds (Valdés, 2006). It was observed that Vitamin C consumption was within desired levels for males and a little above the recommended value for females. Vitamin C is a water soluble vitamin, and a slight excess is easily excreted. Consumption of

both raw and cooked fruits and vegetables was observed, which was mostly met through the snacks eaten throughout the day. However, whether the fortified Vitamin C brands have been identified and calculated by the nutrient analysis software is undetermined.

It is important to analyze folacin in the diet of students, especially women, because it protects women of childbearing age and their babies from neural tube defects (Norsworthy, Skeaff, & Adank, et al., 2004). Current recommendations suggest that all women who may become pregnant consume 400 micrograms of folate each day. To help achieve this goal, grain products now are fortified with folate. In this study, the values of both male and female students consumed adequate folate. The use of lean beef, eggs, fish, and legumes were quite evident from the food records. However, whether the folate fortified breakfast cereals have been identified and analyzed by the software is undetermined.

Sodium is a necessary mineral without which the nerves and muscles would cease to function, the absorption of major nutrients would be impaired, and the body would not be able to maintain adequate water and mineral balance. However, excess sodium is a risk factor for hypertension. Both male and female students consumed significantly higher than the recommended values for sodium. Research suggests that eating high amounts of sodium may contribute to the development of high blood pressure, which may then lead to heart disease, kidney disease, or stroke. Studies suggest that restricting sodium intake to levels below 6g per day, as most international guidelines such as those of the AHA, the US Dietary Guideline Committee, and the Scientific Advisory

Committee on Nutrition recommend, clearly reduces blood pressure (Walker, Mackenzie, & Dunning, 2007). In the current study, the usual diet of students contained processed food, especially canned food, soups, luncheon meats, and frozen foods. Addition of commonly used sodium-laden condiments like salad dressings, sauces, dips, ketchup, mustard, and relish to the meals, either while cooking or at the table, for both males and females was noticeable.

The importance of calcium for young adults is immeasurable as it is the main structural element of bones and teeth and helps in the growth, maintenance, and reproduction of the human body (Cashman, 2007). Deficiency may lead to osteoporosis, which is responsible for 1.5 million bone fractures in the U.S. every year (Brooks, Rajeshwari, & Nicklas, et al., 2006). Students at EMU consumed sufficient amounts of calcium. From the food recall it was quite surprising how the students incorporated both regular and fat-free milk and milk products in their daily diet. Miscellaneous sources of calcium like sesame seeds, blackstrap molasses, corn tortillas, and almonds were also consumed by some students. Vegetarians were found to incorporate greens such as spinach, kale, broccoli, and some legumes and soybean products that are good sources of calcium from plants. Hence the diets were not deficient in calcium.

It was observed that iron was included in the diet for both males and females through a wide use of heme iron sources like animal products as well as fruits, vegetables, dried beans, nuts, and grain products. Iron consumption of male students was slightly above the recommended values but below the upper limit of consumption.

The uses of supplements among the students have not been addressed in the study. The values are all calculated on the basis of the three-day dietary recall. Beans were generously consumed by the students. Oranges, grapefruits, tomatoes, broccoli, and strawberries were some of the common fruits consumed by them, which are rich in Vitamin C and aid in iron absorption.

From the above comparisons it can be said that even though the dietary habits of the EMU students seem to fall within recommended nutrient values, the obesity rate is higher compared to the national data. This can be due to the sedentary lifestyles and lack of physical activities. It is evident from their food records that the students are working towards healthy eating habits and are aware of healthy choices, but there is room for improvement. The biggest challenge is to control portion sizes and estimate a serving size. Starving and skipping meals is also a challenge that leads to overeating at other times. Eating healthy over the long run means there is a place for splurge foods that the students crave on occasion, and very strict diets often make it hard to sustain a good habit. Controlled portion size is necessary to limit fat and calories, but it is the motivation and the dedication to adhere to healthy eating that impacts the overall lifestyle change. However, it is difficult to gauge the grocery choices from the three-day recall and also unrealistic to make conclusions about long-term eating habits. More research and follow-up studies are required.

Healthy living on a daily basis is a challenge. The best way to deal with it is to predict the challenges, plan solutions, and put them into practice. The key ingredient is learning to make positive choices that enhance personal, physical, and mental health.

## Chapter IV – Summary of Findings, Limitations of the Study and Recommendations for further Research and Action

This chapter will give an overview of this study and summarize the findings, limitations, and conclusions based on the results. Recommendations for further research will also be outlined.

### *Summary of Findings*

As discussed earlier, this study was carried out with sixty four female students and thirty six male students at Eastern Michigan University. Body Mass Index, being the most widely used methods for population assessment of overweight and obesity, was calculated from self-reported height and weight. Results indicated that 52% of students fell within the healthy weight category, 28% were considered to be overweight, 16% were obese, and four percent were underweight.

When compared to American College Health Association-National College Health Assessment (ACHA-NCHA) for the years 2004, 2005, and 2006, it was seen that the proportion of underweight students at EMU was similar to that found elsewhere. However, there were fewer students of the healthy weight category and more students who were overweight and obese than students elsewhere.

On average the male students were slightly overweight, whereas female students were within healthy weight.

Statistical studies confirmed that there was no strong linear relationship between BMI and energy intake. The nutrient comparisons were done with two standards, AMDR and DRI. The comparisons of macronutrients with AMDR were within desired limits. When compared to the DRI, consumption of carbohydrates, protein, and sodium was in excess. Consumption of iron, calcium, vitamin C, and Folic acid was within recommended values. There were striking differences in the studies addressed in the review of literature, which suggested that the consumption values were different than the standard American guidelines. In contrast to the research in the past, both male and female students in the current study showed similar characteristics in meal consumption.

Even though consumption of most nutrients adhered to the dietary guidelines, further research is needed to clearly define eating behaviors in college students. Recommendations that can contribute to a better perspective of student nutrition are discussed later in this chapter.

### *Limitations of the Study*

There are limitations that need to be acknowledged and addressed regarding the present study. They include the following.

The first limitation concerns the gender and racial difference of the target population. More males than females participated in the study. EMU student body is composed of students of different cultures and religions, and their food choices and consumption vary and this has not been addressed in the study.

There was no distinction of class status (i.e. graduate versus undergraduate or freshman versus seniors) while recruiting students. The transition would have helped to understand whether these new students had better or worse eating habits than ones who have been here for a few more years or to show whether freshmen changed their habits over the course of years owing to more exposure to campus food awareness programs.

The software that was used for the nutrient analysis was not one of the most current versions. There are current versions in the market today, such as Nutritionist Pro™ Nutrition Analysis Software Version 1.3, an updated version of CompuTrition, which encompasses a broader variety of foods in the database. The software used did not reveal data on some relevant vitamins and minerals like magnesium and vitamin D.

The Body Mass Index was calculated on the basis of the self-reported heights and weights and, as per study, the validity cannot be determined (Larsen, Ouwens, & Engels, et al., 2007). However, BMI is calculated on the basis of self-

reported height and weight in all the national studies like the BRFSS and ACHA-NCHA.

There has been considerable concern about the accuracy and representativeness of self-reported food records. Recording what one really eats correctly is often a struggle. Moreover, it has been seen that students tend to change their eating habits or eat better while keeping food records. The validity and reliability of self-reported food consumption is greatly influenced by the ways people interpret and respond to dietary assessment instruments. This may skew what actually is consumed by the participant (Vuckovic, Ritenbaugh, & Taren, et al., 2000). In this study, educated guesses have been made in some circumstances. The size of the measuring tool of the cups, bowls, and spoons also vary from household to household and hence might not be accurate while reporting.

Finally, there are certain criteria of healthy living that have not been addressed in the study. These include physical activities, use of multivitamin pills or dietary supplements, alcohol consumption, or other poor habits. These would have added a more detailed perspective to the study.

### *Recommendations for Further Research and Action*

It may be helpful to assess a larger group of participants with equal numbers of males and females over a longer period of time. The ethnic differences are relevant, too, because food patterns vary to a great extent between ethnicities, and obesity can also have a genetic influence. Hence to compare their diets with the recommendations might be beneficial. A follow-up study to understand the pattern of whether freshmen are changing their eating habits over the course of years owing to awareness programs may be beneficial for the EMU community. Since American College Health Association-National College Health Assessment (ACHA-NCHA) is the benchmark for college related survey studies, it would be useful to formulate the survey questionnaires and racial highlights as per ACHA-NCHA style.

For the analysis of the nutrients it will be helpful to provide a proper training session to the participants on how to correctly keep a food record. This can be done by showing relevant videos or food models depicting portion and serving sizes of the various food groups. Measuring kits should be made available for the participants through the Office of Nutrition Services, which would include things like measuring cups, measuring spoons, rulers, plastic squares and rounds to measure sizes of pastries or pizza, and small dishes that hold about  $\frac{1}{2}$  cup and 1 cup, so that portions of food can be easily measured and recorded for the food recall. This will also make analysis easier for the nutrition expert who is analyzing the diet.

Using a current or updated version of nutrient analysis software is required. The software must calculate values of total nutrients provided by collection of food items like diet record, menu, or recipe on the basis of the most recent standard of references for the nutrients in the component foods. The software should also include the amount of food in the component and, if possible, highlight how it is processed or prepared. The common software used today is likely to analyze intakes, recipes, meals, meal plans, and physical activities. While it is important to analyze menus for their nutrient content, it is also important that the dietitians review other aspects of the menu, such as variety of foods, serving sizes, color, texture, consistency, and use of seasonal foods, which needs to be a part of the tool as well.

The Body Mass Index was calculated on the basis of the self-reported height and weight, whose reliability cannot be determined. Moreover, it is seen that the readings vary from scale to scale and hence the use of the same weighing scale might be useful from a reliability and validity point of view. For follow-up study, the weighing scale of ONS can be used for measurement each time.

The hydration status is an important factor that contributes to healthy living. Even though it is a common belief that water is just to quench thirst, in reality it is the most essential nutrient in our diet since it is vital to digestion and metabolism and acts as a medium for various enzymatic and chemical reactions in the body. Studies should incorporate the amount of water intake and compare it with the standards and also compare the use of water with other beverages like

tea, coffee, juices, and alcohol, as these are also a significant parcel of most of the students' daily diet.

Students do not always automatically develop the skills, knowledge, attitudes, and behaviors that lead to regular participation in physical activity. Future studies should analyze whether the students have learned the skills necessary to perform a variety of physical activities, are physically fit, participate regularly in physical activity, and know the implications of and the benefits from involvement in physical activities.

Dietary supplements, which include vitamins, minerals, herbs, and other substances taken in the form of pills, capsules, powders, and liquids, are important to note because it may impact the overall health of the students.

To improve the health status of the students at EMU, health fairs and classes can be arranged to discuss these health issues and their solutions. The facility dietitians can help them overcome the challenges. Focus groups can be arranged every six months to discuss the changes they would recommend in an institution. The university can make nutrition and health studies a mandatory part of the curriculum for all students, irrespective of their majors and field of study. In collaboration with the university gym, ongoing weight management classes/packages would be beneficial to provide to the students with minimum or no charge. Holding "Awareness Week" on-campus might help the students to be more motivated in the form of challenges and games. The students can be made a part of many on-campus activities. These can include a 5-A-Day challenge, a 3-A-Day challenge, a 5K run, nutrition screening camp (survey, BMI, height,

weight, B.P.), and a healthy recipe contest, with the winner having his or her meal served at the common eateries at EMU. Prizes and certificates awarded to the winners of each contest will help improve the drive of the students to participate.

To improve the quality of food, healthy choices need to be provided to the students under the guidance of Office of Nutrition Services and dining services. Nutrition information should be made available for every item used in a recipe. Snack corners should be well distributed throughout the campus with innovative and healthy choices. Water from the soda pop fountains should be free to students, and more water fountains should be put in on campus. Water should be readily and visibly available to students on campus at all times. Vending machines on campus should include healthy choices that are clearly marked as healthy by a sticker or a sign. Each vending machine could have a sign or a poster next to it with labels such as Go, Yield, or Stop. All of the foods in the vending machine will be found in one of these categories. It is the hope that students will look at these posters before making a choice at the vending machine and will choose a healthier snack.

## *Conclusion*

The present study determined the consumption of key nutrients of Eastern Michigan University (EMU) students (n=100) ranging in age from 19-30 years and compared their nutrient intake with the current recommended dietary guidelines. BMI was calculated in order to classify whether Eastern Michigan University students were at a healthy weight or belong to underweight, overweight, and obese categories. Results indicated that 52% of students fell within the healthy weight category, 28% were considered overweight, 16% were obese, and four percent were underweight. On average, the male student was slightly overweight whereas the female student was within healthy weight. There was no strong linear relationship between BMI and Energy intake. Consumption of macronutrients with AMDR were within the desired limits. When compared to DRI's, carbohydrates, protein, and sodium were consumed in excess among students. Iron, calcium, vitamin C, and Folic acid were within recommended levels. The obesity rate of EMU students was higher than the average rate of national data even though dietary consumption is mostly within the recommended guidelines. This can be due to the sedentary lifestyles and lack of physical activities. It is evident from their food records that students are working towards healthy eating habits and are aware of healthy choices, but there is potential for improvement for a better diet.

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## APPENDIX A – Human Subjects Approval Letter



## EASTERN MICHIGAN UNIVERSITY

May 15, 2007

Rukmini Sen  
c/o Anahita Mistry, PhD  
School of Health Sciences  
Eastern Michigan University  
Ypsilanti, MI 48197

Dear Ms. Sen,

The CHHS Human Subject Review Committee has reviewed your request entitled "Nutrient Intakes among college students in a midwestern regional university compared to the recommended dietary guidelines", submitted on 5/7/2007. The Committee unanimously agreed that it meets the Minimal Risk standards and the study can be initiated with the following recommendations:

- On the informed consent document, please define the sequence of events in the distribution of questionnaires to address confidentiality issues that may arise
- On the informed consent document state the approximate amount of time that participation will require of the subject
- On the informed consent document, remove the name Stephen Sonstein and replace it with Chair, CHHS Human Subjects Review Committee

The Committee may request further approval if secondary analysis of the data is conducted.

Sincerely,

A handwritten signature in cursive script, appearing to read "Stephen A. Sonstein".

Stephen A. Sonstein, PhD  
Chair, CHHS Human Subjects Review Committee

## APPENDIX B – Letter to the College Deans, EMU

**RUKMINI SEN**

221, North Normal Street, Apt#1, Ypsilanti, MI 48197  
Phone: (734) 754-3220; rsen@emich.edu

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**Date:** \_\_\_\_\_

Dear (Name of the Dean),

I am Rukmini Sen, pursuing my Masters degree in Human Nutrition and Dietetics, Department of Health and Human Services, Eastern Michigan University. I am working on my thesis on “Nutrient Intake In College Students in a Mid Western Regional University Compared to the Recommended Dietary Guidelines”. You are aware that the number of overweight and obese Americans has continued to increase and the trend is not slowing down. Obesity has been an epidemic nationwide. College may or may not be a Petridish for the development of problems in a student’s relationship with food and their body. The purpose of my research study is to evaluate the nutrient intakes of college students at EMU, compare them with the recommended dietary guidelines and calculate Body Mass Index (BMI) to classify whether students are at normal weight or belong to underweight, overweight and obese category. On the basis of the research results measures can be taken in the future to improve overall nutrition of students.

To carry out my thesis I will have to recruit students from all majors to analyze a true picture of the eating patterns of the students. The students, if willing to participate will be given an informed consent form to sign. They will be asked to fill out a survey and complete a three-day food recall. Their participation will be voluntary and no incentives will be provided. The students can opt to drop out anytime during the course of study without any negative consequences. Their responses will be kept confidential and no personal information will be disclosed.

I would be obliged if you could kindly give me the permission to recruit students from your department. If you have any questions feel free to contact me at (734) 754-3220 or email at rsen@emich.edu or Dr. Anahita Mistry at [amistry@emich.edu](mailto:amistry@emich.edu) and Dr. George Liepa at [gliempa@emich.edu](mailto:gliempa@emich.edu). Please find the informed consent form, survey questionnaire, food recall instructions attached with this letter. I look forward to your kind cooperation.

Thank you,

Regards, Rukmini Sen

## APPENDIX C – Student's Informed Consent Form

## EASTERN MICHIGAN UNIVERSITY

## INFORMED CONSENT FOR RESEARCH INVOLVING HUMAN SUBJECTS

**Project Title:** NUTRIENT INTAKE IN COLLEGE STUDENTS IN A MIDWESTERN REGIONAL UNIVERSITY COMPARED TO THE RECOMMENDED DIETARY GUIDELINES

**Principal Investigator:** RUKMINI SEN

**Co-Investigator:** DR. ANAHITA MISTRY, Ph.D., SCHOOL OF HEALTH SCIENCES, EMU

**Purpose of the Study:**

The number of overweight and obese Americans has continued to increase and the trend is not slowing down. Obesity has been an epidemic nationwide. The purpose of this research study is to evaluate the nutrient intakes of college students at EMU and compare them with the recommended dietary guidelines. Body Mass Index (BMI) will also be calculated from the self reported heights and weights in order to classify whether students are at normal weight or belong to underweight, overweight and obese category.

**Procedure:**

You have been invited to participate in a research study. Your participation will include filling out a one-page survey questionnaire that will comprise your self-reported anthropometrics, including height and weight; age; gender; ethnicity; where you mostly eat and whether you reside off campus or on campus. The Nutrient Analysis instructions and template will be attached to the survey. After filling out the survey you will need to complete the food log. You will be asked to maintain a three-day food recall and document the details of their food intake as per the instructions provided and drop them off at Office of Nutrition Services (ONS) at 108 Roosevelt, Eastern Michigan University. The approximate time to fill out the survey and the food log will take 10 to 20 minutes. Your food recall will be entered into the nutrient analysis software. Data will be obtained and nutrient intakes of the most important macro and micronutrients will be examined. They will include total energy intake, fat, protein, carbohydrate, Vitamin C, Vitamin A, Folate, Calcium, Sodium and Iron. The data will be compared to the Dietary Reference Intakes developed by the Food and Nutrition Board (FNB). The study is expected to be done by August 2007. The researcher will be available to answer any questions you have during the study.

## APPENDIX C – Student's Informed Consent Form (continued)

### **Confidentiality:**

The subjects name or personal information will not be identified in the survey or during nutrient analysis. A special coding method will be created and confidentiality will be maintained. At the end of the study the group results will be disclosed. The results will be published in health and related journals. Individual results will not be disclosed. The results will be stored separately from the consent form, which includes your name and any other identifying information. There will be no photographs, video or audio recording during the study. The data will be saved behind cabinets in locked room. Only the principal investigator and researchers will have the access to the data. After the completion of the study the responses will be shredded and destroyed.

### **Expected Risks:**

There are no foreseeable risks to you by completing this study.

### **Expected Benefits:**

Your involvement in this study will provide valuable information to the university about the nutrient intakes of college students and a picture of the number of normal, underweight, overweight and obese category. On the basis of the research results measures can be taken in the future to improve overall nutrition of students and help current students studying at the university eat better.

### **Voluntary Participation:**

Participation in this study is voluntary. You may choose not to participate. If you do decide to participate, you can change your mind at any time and withdraw from the study. Also there will be no negative consequences if you choose not to participate in the study.

### **Use of Research Results:**

Group results will be disclosed only. No names or individually identifying information will be revealed. Results may be presented at research meetings and conferences, in scientific publications, and as part of a master's thesis being conducted by the principal investigator.

### **Questions About this Study:**

If you have any questions concerning your participation in this study, you can contact Dr. Anahita Mistry at [amistry@emich.edu](mailto:amistry@emich.edu) and Dr. George Liepa at [gliepa@emich.edu](mailto:gliepa@emich.edu).

## APPENDIX C – Student's Informed Consent Form (continued)

**Human Subjects Review Board:**

This research has been approved by College of Health and Human Services, EMU Human Subjects Review Committee. If you have any questions about the approval process, you may contact the Chair, CHHS Human Subjects Review Board at (734) 487-1238.

**Consent to Participate:**

I have read all of the above information about this research study, including the research procedures, possible risks, side effects, and the likelihood of any benefit to me. The content and meaning of this information has been explained and I understand. All my questions, at this time, have been answered. I hereby consent and do voluntarily offer to follow the study requirements and take part in the study.

**PRINT NAME:** \_\_\_\_\_

**SIGNATURE OF THE PARTICIPANT:** \_\_\_\_\_ **DATE:** \_\_\_\_\_

**SIGNATURE OF THE INVESTIGATOR:** \_\_\_\_\_ **DATE:** \_\_\_\_\_

## APPENDIX D – Survey Questionnaire

**SURVEY QUESTIONNAIRE**  
**[PLEASE CHECK WHERE APPROPRIATE]**

DATE: \_\_\_\_\_

1] CODE: \_\_\_\_\_ #: \_\_\_\_\_ [Please leave it blank]

2] AGE: \_\_\_\_\_ 3] MALE: \_\_\_\_\_ FEMALE: \_\_\_\_\_

4] CURRENT WEIGHT: \_\_\_\_\_ (IN POUNDS) 5] HEIGHT: \_\_\_\_\_

6] ETHNICITY:

a. White / Caucasian: \_\_\_ b. Black / African American: \_\_\_

c. Asian: \_\_\_ d. Hispanic / Latino: \_\_\_ e. Other: \_\_\_\_\_

7] DO YOU LIVE a. ON-CAMPUS \_\_\_ b. OFF-CAMPUS \_\_\_

8] DO YOU REGULARLY EAT BREAKFAST: a. YES \_\_\_ b. NO \_\_\_

9] HOW MANY MEALS DO YOU EAT EVERYDAY: a.3: \_\_\_ b.2: \_\_\_ c.1: \_\_\_  
d. NONE: \_\_\_

10] HOW MANY MEALS DO YOU PURCHASE AND CONSUME OUTSIDE OF YOUR RESIDENCE:

	YES	NO		YES	NO
a. EVERYDAY			d. LESS THAN ONCE A WEEK		
b. 3-5 TIMES/WEEK			e. RARELY		
c. 1-2 TIMES/WEEK			f. NEVER		

11] AT WHAT RESTAURANTS DO YOU MOST FREQUENTLY EAT:  
\_\_\_\_\_

12] HOW MANY DAYS PER WEEK DO YOU EXERCISE: a. 0-2: \_\_\_\_\_

b. 3-4: \_\_\_\_\_ c. 5-7: \_\_\_\_\_

THANK YOU FOR YOUR TIME

## APPENDIX E – Nutrient Intake Form

**FOOD DIARY (need 3 days)**

Date \_\_\_\_\_ Gender \_\_\_\_\_ Age \_\_\_\_\_ Height \_\_\_\_\_ Weight \_\_\_\_\_

DAY 1				
TYPE OF FOOD	BREAKFAST	LUNCH	DINNER	SNACKS
DAIRY  (Milk, cheese, cottage cheese, yogurt)				
MEAT AND PROTEIN  (Includes beans and nuts)				
VEGETABLES AND FRUITS				
BREADS AND CEREALS				
FATS AND OILS				
OTHER				

DAY 2				
TYPE OF FOOD	BREAKFAST	LUNCH	DINNER	SNACKS
DAIRY (Milk, cheese, cottage cheese, yogurt)				
MEAT AND PROTEIN (Includes beans and nuts)				
VEGETABLES AND FRUITS				
BREADS AND CEREALS				
FATS AND OILS				
OTHER				

DAY 3				
TYPE OF FOOD	BREAKFAST	LUNCH	DINNER	SNACKS
DAIRY  (Milk, cheese, cottage cheese, yogurt)				
MEAT AND PROTEIN  (Includes beans and nuts)				
VEGETABLES AND FRUITS				
BREADS AND CEREALS				
FATS AND OILS				
OTHER				

## APPENDIX F – Nutrient Intake Record Instruction Sheet

### NUTRIENT INTAKE IN COLLEGE STUDENTS IN A MIDWESTERN REGIONAL UNIVERSITY COMPARED TO THE RECOMMENDED DIETARY GUIDELINES

#### INSTRUCTION SHEET

- Complete the food record for 3 days. Record complete information for preferably 2-week days and 1 weekend day.
- Include diet / menu that you usually follow and not special events like birthday, anniversary or other parties of any kind.
- Be as specific and as accurate with information as possible. For example if you are having bagel with cream cheese, mention (type of bread – wheat or white; the amount); (type of cream cheese – light or regular, the amount – in teaspoons)
- Include a complete description of the food along with the amount eaten. This will help make the nutrient analysis as accurate as possible. For example if you are having the Mexican quesadilla mention whether it is chicken or beans, whether it has cheese in it, do you have sour cream or guacamole with it, whether you have added vegetables to it as well.
- Identify food items or ingredient such as fully cooked, frozen or raw.
- If the product is commercially prepared, enter the name of the manufacturer and/or brand name.
- Enter the serving size description associated with the base weight (oz, cup, each)
- Drop the completed form off at the Office of Nutrition Services at 108 Roosevelt, Eastern Michigan University.
- Please note that individual results will not be disclosed. There will be no charges for this participation.
- If you have any questions contact the researcher, Rukmini Sen at (734) 754-3220 or email at [rsen@emich.edu](mailto:rsen@emich.edu)

## APPENDIX G – List of Abbreviations Used

AMDR: Acceptable Macronutrient Distribution Range

AI: Adequate Intake

BRFSS: Behavioral Risk Factor Surveillance System

BIA: Bioelectrical impedance analysis

BMI: Body Mass Index

CDC: Centers for Disease Control and Prevention

DRI: Dietary Reference Intake

EMU: Eastern Michigan University

EAT-26: Eating Attitudes Test-26

EAR: Estimated Average Requirements

FDA: Food and Drug Administration

FNB: Food and Nutrition Board

IOM: Institute of Medicine

ONS: Office of Nutrition Services

RDAs: Recommended Dietary Allowances

RDI: Reference Daily Intake

RD: Registered Dietitian

ACHA-NCHA: The American College Health Association-National College Health Assessment

HHS: The U.S. Department of Health and Human Services

ULs: Tolerable upper intake levels

USDA: United States Department of Agriculture