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A Cross-Sectional Study: Dietary Micronutrient Levels in Allied Health and Nursing Students

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Abstract

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MPH, Florida International University, 2000

MD, Universidad Central Del Este, 1986

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Dissertation Submitted in Partial Fulfillment

of the Requirements for the Degree of

Doctor of Philosophy

Public Health Epidemiology

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Abstract

The adequate intake of micronutrients is important to maintain optimal health and prevent nutritional disorders and chronic disease. Studies have shown that medical students often reduce self-care behaviors and lack adequate dietary intake, leading to nutritional deficiencies. In this quantitative cross-sectional study, measurements of micronutrient levels in a sample of allied health and nursing students were compared to Recommended Daily Allowance (RDA) values. NutritionQuest Data-on-Demand System was used to analyze nutrients and food group intake. The postpositivist paradigm was used to examine how the independent and dependent variables relate to each other. Using a one-sample *t* test, a comparison of average micronutrient intake among study participants with RDA values for those micronutrients showed that average micronutrient intake in the study population was higher than recommended values. Two sample *t*-test results showed no significant difference in average intake of micronutrients among participants with high and low income levels, or with high and low stress levels. As the normality assumption was not satisfied by the outcome variables, nonparametric tests were used to evaluate hypotheses. While this finding does not support the original hypothesis, it could have implications for the role of allied health and nursing practitioners in the care of both their patients and members of their medical team. Conversely, an assumption of this study was that a high level of similarity between the traditional medical student population and the allied health and nursing population in terms of nutritional habits may have led to a flaw in the overall research hypothesis. The detection of micronutrient deficiencies in students can bring awareness to improve nutritional intake and initiate a change in how public health officials advocate healthy and balanced diets.

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Dedication

I dedicate this dissertation to my mother, Julia Esther Cruz Sanchez, my sons, Eliseo de Jesus Espaillat, Jr. and Julyan Elishah Espaillat, and my sister, Martizael Lanza. Thank you for the support, encouragement, and constant love that have sustained me throughout my life. I also thank my husband, Dr. Eliseo de Jesus Espaillat, for his support.

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Chapter 1: Introduction to the Study

Introduction

The human body requires nutrients that are commonly divided into two categories, macronutrients and micronutrients (Institute of Medicine [IOM], 2006). *Macronutrients* are generally consumed in larger amounts or grams and are nutrients such as proteins, carbohydrates, fats, and alcohol. *Micronutrients* are consumed in smaller amounts (IOM, 2006). This research focused on the micronutrient consumption in the diets of allied health and nursing students. The study specifically focused on Vitamins A, B, B12, C, D, E, and K and the minerals iron, calcium, zinc, and folate. Stress and income levels were also compared among students in the allied health and nursing programs at Keiser University. This chapter provides background on micronutrients and micronutrient deficiency and provides the main purpose for this research study. Postpositivist theory is also introduced in this chapter, as it is the base theory for this research. The rationale for the selection and design of this study is presented later in this chapter, along with definitions relevant to this research study. This primary research has several assumptions and possible limitations associated with this course of micronutrient research; these points are identified and described in detail in this chapter. This chapter ends with the significance of this study and its potential contributions to public health.

Micronutrients are defined as “essential vitamins and trace minerals” (Black, 2003, p. 79). Micronutrient deficiency is typically the result of insufficient nutritional intake, improper administration of micronutrients or various irregular absorption rates, and biochemical processing (Sriram & Lonchyna, 2009). Allen (2003) explained the importance of understanding the causes and impact of micronutrient deficiency on the body. For example, insufficient intake of essential vitamins and minerals can result in cardiovascular disease, diabetes, and cancer (Ames, 2006; Black, 2003; Sriram & Lonchyna, 2009). Additionally, inadequate intake of specific micronutrients can affect the immune system, resulting in opportunistic diseases and infections (Wannamethee, Lowe, Rumley, Bruckdorfer, & Whincup, 2006).

Chakravarty (2002) explained that the prevalence of micronutrient deficiency is an important public health issue. The World Health Organization (WHO, 2012) previously established the importance of micronutrient deficiency through the development of the Micronutrient Deficiency Information System in 1991. The importance of each micronutrient cannot be overstated. The following are indicators of why micronutrient deficiency is a public health concern:

1. "Two billion people—over 30% of the world's population—are anemic due to iron deficiency" (WHO, 2012);
2. "Micronutrient deficiencies affect nearly half of humanity" (Mason, Lotfi, Dalmiya, Sethuraman, & Deitchler, 2001, p. 1);
3. "Half of the U.S. population may be deficient in at least one of these micronutrients" (Ames, 2001; Ames & Wakimoto, 2002 (as cited in Ames, 2005, p. 521); and
4. "Iron deficiency is thought to be the most common cause of anemia globally, although other conditions, such as folate, vitamin B12 and vitamin A deficiency, chronic inflammation, parasitic infections, and inherited disorders can all cause anaemia" (WHO, 2012).

While the statistics above are startling, research has also shown that certain populations are more at risk than others. For example, Lukaski (2004) examined the result of iron and magnesium deprivation in healthy athletes. The results of the study indicated that iron deficiency caused impaired muscle functions and that magnesium deficiency increased oxygen requirements in exercise, resulting in reduced performance endurance.

This study was designed to estimate the levels of micronutrients in a sample of freshman male and female allied health and nursing students at Keiser University. The student population consists of multiple ethnicities and ages, and a representative sample of students was used in this study. This study used a food-frequency questionnaire and other instruments for recording and analysis of dietary intakes after students were deemed eligible to participate in the study. The specialized nutritional software implemented in this research study estimated levels of micronutrients and compared them to Recommended Daily Allowances (RDA). The calculated student RDA levels were compared to each student's stress level (high vs. low), and income level (high vs. low). The Perceived Stress Scale (PSS) was used as the assessment instrument to measure individual stress levels. *t* tests and the multiple linear regression model were used to analyze the data in the study. The detection of micronutrient deficiencies in allied health and nursing students can bring awareness to improve nutritional intake in future public health practitioners and initiate a change in how public health officials advocate healthy and balanced diets at all ages, a potential finding that would serve as an important public health implication in this study.

Background

Many researchers have explored the link between nutrition and college students (Ha, Caine-Bish, Holloman, & Lowry-Gordon, 2009; Seabolt, Spence, & Silver, 2012). Few researchers, if any, have looked at the impact of micronutrient deficiency in relation to student stress and income. Ha et al. (2009) reported that college students' transitional lifestyles are related to poor eating habits. Ha et al. used a sample of 80 college students to assess the effect of nutrition education courses on soft drink and milk consumption. They also explained that the transition to adulthood is marked not only by a separation from parents, but also by susceptibility to developing unhealthy behaviors. Sira and Pawlak (2010) identified a need for obesity prevention in college students and lifestyle modification programs. They conducted a cross-sectional study of college students to determine rates of obesity and overweight students. The results of this study supported the generally held belief about the unhealthy nutritional attitudes and behaviors of college students.

Garcia, Long, and Rosado (2009) demostrated that obese individuals have lower blood concentration in micronutrients and minerals (vitamin A, vitamin D, vitamin K, several B vitamins, zinc, and iron). Furthermore, health professionals are not immune to the obesity epidemic. Several studies have demonstrated that physicians are overweight or obese (Ajani et al., 2004; Arora, Lettieri, & Claybaugh, 2004). Overweight physicians are less likely to counsel patients about obesity (Lesser, Cohen, & Brook, 2012). Lesser et al. (2012) emphasized that "just as patients are advised to increase their consumption of fruits, vegetables, and whole grains, it is time to incorporate this advice into meals served in health care settings, so healthcare professionals can practice what they preach" (p. 293).

Previous findings suggest that additional research related to the health of medical students and nutritional intake needs to be conducted. One assumption of the general population is that healthcare professionals acquired healthy dietary lifestyles as medical students. Seabolt et al. (2012) demonstrated that these assumptions may be mistaken. Four hundred and nine second-year medical students participated in a study conducted by Seabolt et al. The results were that 87.3% of male students had inadequate food intake for vitamin E, vitamin D, calcium, magnesium, and potassium, while 51.8% of the female students had inadequate food intake for vitamin D, vitamin E, calcium, potassium, magnesium, and iron (Seabolt et al., 2012). Food intake was measured by the Block Brief 2000 food frequency questionnaire and compared to the Dietary Reference Intake values. The data were analyzed using SPSS (version 15.0). For example, in males, the data collected for vitamin E indicated that students obtained this vitamin mainly from consuming chips, salad dressing, and peanut butter (Seabolt et al., 2012). According to the Seabolt et al. findings, inadequate intake of micronutrients may be associated with multiple factors. These multiple factors include (a) time constraints in the medical school environment; (b) an increase in levels of stress, which can contribute to change of appetite and eating behaviors; (c) economic considerations that can influence food purchasing patterns; and (d) body image perception, which may limit the amount of food consumed. Seabolt et al. also explained that even in a population in which some medical students believe that they are following healthy diets, inadequate nutritional intake is still a concern.

Van den berg, Okeyo, Dannhauser, and Hel (2012) did a cross-sectional descriptive survey of 161 undergraduate nursing students. The study found a high prevalence of overweight and obese participants, unhealthy eating habits, and inadequate knowledge of basic nutrition and dietary requirements. Approximately 49.7% were overweight or obese; 97.5% ate less than three servings per day of the recommended vegetable group intake, while 42.2% ate less than two servings per day of the fruit group intake (Van den berg et al., 2012). The daily food intake consisted of substantial portions of margarine, oil, or fat (68.3%); sugar (59%), and bread (55.9%), whereas low dietary intake of vegetables (12.4%); fruit (23.6%); fruit juice (21.2%), and milk (15.6%) was reported. Fewer than 50% of the nursing students knew the recommended intake for vegetables, fruit, dairy, starchy food, meats, and meat alternatives (Van den berg et al., 2012).

The burden of morbidity and mortality from cardiovascular disease can be attributed to nine modifiable risk factors (smoking, diabetes mellitus, dyslipidemia, central obesity, hypertension, imbalanced diet, physical inactivity, excessive alcohol consumption, and psychosocial factors), as demonstrated in the INTERHEART study. The INTERHEART study showed that more than 90% of global myocardium infarction can be attributed to these nine modifiable risk factors (Yusuf et al., 2004). In a cross-sectional study, 208 doctors working at the Lady Reading Hospital were interviewed. Food pattern analyses showed that 37% of the doctors were having meals in canteens or restaurant, while 76% ate regular snacks during duty hours (Qureshi et al., 2012). In addition, weekly consumption of vegetables was less than 1,000 grams in 88% of the doctors, and fruit consumption was less than 1,000 grams in 78% of the doctors. Meat consumption was less than 500 grams in 75% of doctors, and only 2.4% were regularly consuming fish in amounts more than 500 grams a week. According to Qureshi et al. (2012), these percentages suggest a strong trend toward unhealthy eating habits. Seventy-five percent of the doctors were not regularly exercising, and 53% were overweight or obese. Furthermore, 21.15% were found to have blood cholesterol more than 180 mg.dl (hypercholesterolemia), which contributes to cardiovascular morbidity and mortality. Active smoking was another factor found in 18.8% of the doctors (Qureshi et al., 2012). The study was able to demonstrate that physical inactivity, obesity, unhealthy eating, and smoking were more frequent amongst doctors. Physical inactivity, obesity, unhealthy eating, and smoking are modifiable health risk behaviors that are linked to chronic diseases such as cardiovascular disease, cancer, stroke, hypertension, and diabetes, contributing to 70% of all deaths in the United States (Danaei et al., 2009).

Reiner, Sonicki, and Tedeschi-Reiner (2012) created a cross-sectional survey to measure the perception and knowledge of some of the cardiovascular disease risk factors among freshmen and graduating medical students. More than 30% of the graduating students were smokers and had low awareness of obesity as an important cardiovascular disease risk factor, while 14% of freshmen were smokers (Reiner, Sonicki, & Tedeschi-Reiner, 2012). Building on the recommendations suggested by Seabolt et al. (2012), this study was designed to investigate the nutritional intake of a sample of first-year students enrolled in the Allied Health and Nursing Department at Keiser University in Miami, Florida. This study examined micronutrient levels in these first-year students and determined whether income and/or stress levels were related to poor nutritional uptake.

Improving healthy eating behaviors in allied health and nursing students may influence their willingness to change the way they treat their future patients with similar nutritional conditions and reduce the risk for illness and death due to chronic diseases. Chronic diseases such as diabetes, cancer, and cardiovascular diseases are the leading cause of disability and death in the United States and account for approximately $7,500 in medical care for every American (Centers for Disease Control and Prevention [CDC], 2012). Healthcare costs for cardiovascular diseases and strokes are about $432 billion per year (Mensah & Brown, 2007), while the total cost for diabetes is about $218 billion per year (American Diabetes Association [ADA], 2013). According to the CDC (2012), chronic diseases limit the daily living of 1 out of 10 Americans.

Statement of the Problem

Micronutrients are essential vitamins and minerals. The adequate intake of micronutrients is important to the maintenance of a healthy body and the prevention of micronutrient deficiency-related diseases (Misner, 2006; WHO, 2008). Misner (2006) demonstrated that food intake alone did not provide the RDA requirements for vitamins A, D, E, K, B1, B2, B3, B6, B12, and folate or the minerals iodine, potassium, calcium, magnesium, phosphorus, zinc, and selenium. Furthermore, the study demonstrated that males had an average of 40% vitamin deficiency and 54.2% essential minerals deficiency. Women had a 29% vitamin deficiency and 44.2% minerals deficiency (Misner, 2006).

Micronutrient deficiency can contribute to various diseases. Vitamin B12 deficiency is associated with multiple diseases, particularly neuropsychiatric manifestations and neurological complications (Butler et al., 2006; Holst-Schumacher, Monge-Rojas, & Barrantes-Santamaria, 2007). Bor et al. (2010) highlighted that higher prevalence rates (8.7%) of vitamin B12 deficiency (serum vitamin B12 <148 pmol/L) have been empirically established in elderly populations. The Framingham Offspring study found similar rates (8.2%) in a younger, seemingly healthier population. According to the World Health Organization (WHO), iron deficiency was categorized as one of the 10 most serious health problems in the modern world (McLean, Cogswell, Egli, Woidyla & Benoist, 2009; WHO, 2008). It has also been reported that a mild magnesium (Mg) deficiency may cause nervousness, irritability, mental depression, confusion, twitching, trembling, apprehension, insomnia, muscle weakness, and cramps (Eby & Eby, 2010). The National Institute of Mental Health (NIMH, 2011) purported that approximately 6.7% of the U.S. population experience depression and 30.4% of these cases are classified as severe depression. Compared to adults over the age of 60, (a) 18-29 year olds are 70% more likely to have experienced depression over their lifetime, (b) 30-44 year olds are 120% more likely, and (c) 45-59 year old are 100% more likely (NIMH, 2011).

Inadequate nutrition intake in children, adolescents, and adults can lead to a variety of problems, ranging from poor academic achievement, inadequate intake of the micronutrients, and poor health to an increase in developing chronic diseases, such as diabetes and cardiovascular diseases, and poor psychological and cognitive functions (Sijbesma & Sheeran, 2012, p. 58; WHO, 2008). Inadequate levels of micronutrients can also lead to various health issues. For example, the major function of vitamin K is to clot blood and stop blood vessels from becoming calcified or stiffened. Inadequate levels of vitamin K can lead to heart disease later in life (Sijbesma & Sheeran, 2012, p. 60).

Vitamin D deficiency has been found in more than 50% of children and adults in the United States (Holick, 2010). Vitamin D deficiency in adults can exacerbate osteoporosis and cause osteomalacia and can be misdiagnosed as fibromyalgia (painful bone and muscle aches; Holick, 2010; Jones & Hansen, 2009; Khokhar & Lipman, 2012; Sriram & Lonchyna, 2009). In addition, vitamin D deficiency in adults has been shown to be associated with (a) colon, prostate, and breast cancer by as much as 50%; (b) increased heart attack risk by 50%; (c) type II diabetes by 33%; and (d) peripheral vascular disease by 80% (Holick, 2010; Sijbesma & Sheeran, 2012). At the end of 2010, it was recommended that children in the United States consume 200-400 units of vitamin D a day and adults 1,000 units a day (Holick, 2010; Sijbesma & Sheeran, 2012).

There are several clinical manifestations that result from malnutrition associated with other micronutrients. For example, clinical manifestations of vitamin A deficiency include blindness, poor bone growth, xerophthalmia, dry skin, and increased risk of infections (Khokhar & Lipman, 2012; Sriram & Lonchyna, 2009). One of the most common nutritional deficiencies demonstrated worldwide is folate. In the United States, it has been reported that 15% of childbearing women have inadequate storage levels of folate and are more susceptible to having infants with low birth weight, low Apgar scores, and neural tube defects (Khokhar & Lipman, 2012; Sriram & Lonchyna, 2009). Vitamin B12 deficiences as a result of malnutrition often result in fatigue, poor memory, megaloblastic anemia, mania, psychosis, and impaired touch including pressure and vibration sensation (Khokhar & Lipman, 2012; Sriram & Lonchyna, 2009). Vitamin C deficiency is a result of diets that lack fresh fruits and vegetables. Though vitamin C deficiency is uncommon in the United States, it has been diagnosed in malnourished patients (Khokhar & Lipman, 2012). Vitamin C deficiencies may result in clinical signs of malnutrition that include petechiae, perifollicular hemorrhages, inflamed and bleeding gums, arthralgias, myalgias, lethargy, and submucosal gastrointestinal problems (Khokhar & Lipman, 2012; Sriram & Lonchyna, 2009). Tables 1 and 2 provide additonal information on specification of function, deficiency, and manifestations and clinical signs of malnutrition for vitamins A, B12, D, C, E, K, folic acid, and zinc.

Though research has demonstrated that medical students report having good health behaviors compared with other young adults in United States, adjustment to the rigors of medical school has been proven to reduce self-care behaviors (Dyrbye, Thomas, & Shanaflet, 2006; Kushner, Kessler, & McGaghie, 2011). According to Kushner et al. (2011), it is important for medical students to establish and maintain personal health habits, as these habits can affect their academic performance, emotional regulation, and future functioning as physicians.

In a cross-sectional systematic review of depression, anxiety, and psychological distress among U.S. and Canadian medical students, Dyrbye et al. (2006) concluded that student distress may influence professional development and can contribute to substance abuse, broken relationships, decline in physical health, poor self-care (poor diet and lack of exercise), and suicide (Dyrbye et al., 2006). Physician suicides have become an important public health problem in the United States. The rate of suicide among physicians is higher than in the general population and has been found to be related to job stress (Gold, Sen, & Schwenk, 2012). In a previous study conducted by Schwenk, Gorenflo, and Lejia (2008), it was reported that 81% of physicians had an increase of professional stress level, while 91% reported that depression had decreased work satisfaction.

Healthcare professionals have the responsibility to take care of patients, yet ironically they do not take care of themselves. Working in the medical field comes with a lot of responsibilities, and stress and lack of time play important roles in neglecting self-care. The statistics on comorbidities in doctors, nurses, and other staff are alarming, from diseases (cardiovascular and cancer) to psychological effects (suicide) associated with risk factors such as overweight, smoking, and stress. These risk factors predispose medical professionals to the same health conditions as the very people they are treating, an ironic result of their not adhering to their own advice or treatment plans.

One issue seen in medical professionals is the alteration of the circadian rhythm. Shift work sleep disorder is commonly seen in those who work nights or rotating shifts. Working on different shifts, without a specific frame of time, can affect the circadian rhythm, which is the biological clock for humans (Sack et al., 2007). The U.S. Department of Labor and OSHA regulations have tried to establish an equilibrium for the work of health professionals, and measures have been addressed to diminish this problem (U.S. Department of Labor, 2010), but none have been successful in establishing proper feeding and sleeping patterns. These patterns are often associated with the presence of hospital emergencies and concern for patient care and can contribute to bad alimentary and sleep habits. Alterations of both factors can lead to hypertension, fatigue, insomnia, and finally sleep deprivation (Gangwisch, Feskanich, Malaspina, Shen, & Forman, 2013).

Dyrbye et al. (2006) and Kushner et al. (2011) encouraged researchers to investigate the causes and consequences of medical student distress (Dyrbye et al., 2006) and medical students' good health habits (Kushner et al., 2011) that can benefit not only the individual, but also patient care. This study was designed to (a) estimate micronutrient levels in a sample of allied health and nursing students, (2) compare these levels to the recommended daily allowances for these micronutrients, (3) compare the estimated micronutrient levels to the students' income level (high vs. low), and (4) compare the estimated micronutrient levels to students' stress level (high vs. low) in a sample of first-year allied health and nursing students.

Purpose of the Study

The purpose of this research was to determine the level of micronutrient intake in allied health and nursing students by measuring dietary intake. In this quantitative cross-sectional study, I sought to (1) estimate micronutrient levels, (2) compare micronutrient levels to the recommended daily allowances, (3) compare the estimated micronutrient levels of high-income and low-income students, and (4) compare the estimated micronutrient levels of students experiencing high stress and low stress levels in a sample of first-year allied health and nursing students from Keiser University. The dependent variable in the study was micronutrient levels. The independent variables in the study were stress and income levels. A cross-sectional survey design was used in this quantitative research study. A random sample of students was selected from the freshman enrollment class in the Allied Health and Nursing Department. Random sampling was used in this study. When a random sample is used, each subject has an equal probability of being selected, resulting in an unbiased representative sample of participants (Creswell, 2009). A cross-sectional survey design was applied in this study by using face-to-face interviews (Phase I) and a web-based self-administered questionnaire (Phase II). In Phase I, I conducted a prescreening survey to determine whether participants were eligible to proceed to Phase II of the research study. In Phase II, study participants completed nutritional analysis surveys via a computer-assisted self-interview (CASI) system. CASI has traditionally been used to collect data of a sensitive nature, such as drug usage or illegal activities (Couper & Rowe, n.d.). More recently, CASI has been used to collect attitudinal data. NutritionQuest, an adapted database used for collecting selection of foods that are acquired from the National Health and Nutrition Examination Survey (NHANES; NutritionQuest, 2009), was used as the nutritional software. NutritionQuest's Data-on-Demand System was used to analyze each food frequency question by using USDA values. The system was able to estimate selected nutrient intake and compare each individual's intake with the RDA values.

The prescreening interviews and the self-administered nutritional analysis survey on the CASI system were collected and submitted for data analysis using the Statistical Package for the Social Sciences (SPSS) for Mac version 21.0. The six-step process for analyzing quantitative data in social research was applied (Creswell, 2009). In this process, Creswell (2009) outlined the following steps: (1) present descriptive statistics, (2) present demographic information about the sample participants, (3) conduct descriptive analysis of data (including mean, standard deviations, and range of scores on dependent and independent variables), (4) check for reliability and validity of the data, (5) conduct hypothesis testing, and (6) provide the interpretation of the results (Creswell, 2009). NutritionQuest was used to collect electronic data on nutrient intake in participants. The Block Rapid Food Screeners Questionnaire was used to assess the dietary intake of students. The Full-Length Block Food Frequency Questionnaire was used in Phase II of the study. The Perceived Stress Scale (PSS) was used to measure the extent of the participants' perception of stress in their lives.

This study implies that allied health and nursing students have decreased nutritional intake during the transition into being independent college students, while taking on the rigors related to an intensive academic and career training schedule. According to Kushner, Kessler, and McGaghie (2011), medical professionals tend to make healthier choices than the general population; however, studies have indicated that there is still a need to improve the lifestyles and behaviors of this population of medical workers (Kushner et al., 2011). For example, the IOM (2004) stated that medical professionals who practice healthy behaviors tend to have more influence on changing the behaviors of their patients. This finding indicates that a ripple effect can occur when the eating habits of medical professionals are improved. Nevertheless, there are other contributing factors that impact the prevalence of micronutrient deficiencies, including social, economic, and environmental factors. If healthcare professionals put into practice what they are encouraged to implement in their patients, there are implications of improved physical health and improved psychosocial development.

Research Question and Hypotheses

The main question to be answered in this research was the following: Are there differences between micronutrient intake levels in allied health and nursing students at Keiser University on the Miami, FL campus when RDA levels are compared? The roles of income and stress levels in the micronutrient uptake of study participants were also examined. The dependent variable was micronutrient levels. The independent variables were stress and income levels. The aim of the study was to answer the following research questions:

1. Are there differences between micronutrient intake levels in allied health and nursing students at Keiser University on the Miami, Florida campus when RDA levels are compared?

   $H0_1$: There is no significant difference between the levels of micronutrients estimated in a sample of first-year allied health and nursing students and the RDA for each micronutrient.

   Ha_1: There are differences between the levels of micronutrients estimated in a sample of first-year allied health and nursing students and the RDA for these micronutrients.

2. Do micronutrient levels in allied health and nursing students at Keiser University on the Miami, FL campus differ by students' income status?

   $H0_2$: There is no significant difference between the levels of micronutrients estimated in a sample of low-income first-year allied health and nursing students compared to high-income students.

   Ha_2: There are differences between the levels of micronutrients estimated in a sample of low-income first-year allied health and nursing students compared to high-income students.

3. Do micronutrient levels in allied health and nursing students at Keiser University on the Miami, Florid, campus differ according to stress level?

$H0_3$: There is no significant difference between the levels of micronutrients estimated in a sample of low-stress first-year allied health and nursing students and the levels of high-stress students.

Ha_3: There are differences between the levels of micronutrients estimated in a sample of low-stress first-year allied health and nursing students and the levels of high-income students.

Theoretical Framework

This study incorporated principles outlined by the postpositivist worldview. The postpositivist philosophy stems from the same framework as the positivist framework. The positivists believed that the objective of science was to measure only what can be observed (Trochim & Donnelly, 2009). It was the positivists who developed the scientific approach that is used today in medical research (Babbi, 2010). Ulin, Robinson, and Tolley (2005) suggested that the history and foundation of population research was rooted in the principles of positivist philosophy. This assertion is supported by the quantitative methods used in population research associated with morbidity and mortality studies, as well as epidemiological surveillance techniques (Ulin et al., 2005). In postpositivist research, dialogue is used as a tool to acquire truth from respondents during an interview. Researchers can not be "positive" about claims of knowledge when studying the actions of human behaviors. Postpositivism reflects a need to examine causes that influence outcomes (Creswell, 2009). According to Ritchie and Rigano (2001), it seems appropriate to open up the interpretive discussion with the respondents in order to share thoughts on how the ideas might be used (Ritchie & Rigano, 2001). Postpositivism is also reductionist in that it tests selected variables that constitute hypotheses and research questions based on careful observation and measurement of the objective reality in the world (Creswell, 2009). Therefore, research is for testing or refining existing laws or theories (Creswell, 2009).

The postpositivist paradigm was used in this study to measure and compare the levels of micronutrients in a sample of allied health and nursing students according to RDA, stress level, and income. The statistical data analysis performed was able to determine the extent of the relationship between the levels of micronutrients and the RDA. These calculated results from students were then used to compare high-income versus low-income students, and students with high stress levels versus students with low stress levels. These statistical results were also used to predict the possible associations with the research hypotheses in this study.

Nature of the Study

This study used a cross-sectional survey design with the use of face-to-face interviews and a web-based self-administered questionnaire. A nonexperimental cross-sectional survey design was used to conduct this study. Surveys are an ideal way to quantitatively explore or identify trends. The cross-sectional study design was chosen because, according to Babbie (2010), a cross-sectional design is often used as an exploratory or descriptive method to find inferences about possible relationships or to gather preliminary data to support further research and experimentation. Creswell (2009) also explained that a survey design allows a researcher to generalize about a population's trend through the use of a sample (p. 145). The use of surveys as a research technique dates back to the biblical era (Babbie, 2010). The survey has been identified as the best method available for collecting original data to describe a population. Surveys are typically used when the unit of analysis is at the individual level. This study was not designed to identify any causal relationship; as such, use of a cross-sectional survey design was most appropriate.

The dependent variable was micronutrient level. The independent variables were stress and income levels. A one-sample *t* test was used to determine micronutrient levels and RDA values. A two-sample *t* test and multiple linear regression models were used to compare the micronutrient RDA levels of high-stress versus low-stress and high-income versus low-income students. In addition, the multiple linear regression model were included gender to adjust for potential confounding by this variable.

Definitions

The following definitions are provided to ensure uniformity and understanding of these terms throughout the study. *Adequate intake* (AI) is "established when evidence is insufficient to develop an RDA and is set at a level assumed to ensure nutritional adequacy" (NIH, 2012). *Deficiency* is a lack or shortage of an essential metabolic substance, such as a vitamin or mineral, that is essential in minute amounts for the proper growth and metabolism of a living organism (CDC, 2006). *Recommended Daily Allowance (RDA)* is the "average daily level of intake sufficient to meet the nutrient requirements of nearly all (97%-98%) healthy people" (National Institutes of Health [NIH], 2012). *Suboptimal* refers to low intake of micronutrients (Gross, 2005). *Stress level* "refers to the emotional, cognitive, behavioral, and physiological reactions experienced when a person confronts a situation in which the demands exceed their coping resources" (Kasparian, 2013, p. 41).

Assumptions

In every research study, the ultimate goal is to obtain sufficient and valid data that are reproducible and considered acceptable research by the scientific community (Creswell, 2009). An assumption of this study is that many students consider themselves healthy, although they may have deficiencies in some of the primary micronutrients. This research study was open to all ethnicities, gender groups, and people aged 18 through 40 at the Keiser University Miami, FL campus. The next assumption in this study was that the student population represented in this random sampling is a accurate representation and that any conclusions drawn from this research can be associated with or applied to the general population of allied health and nursing students. Another assumption of this study was that the students provided total household income and not only individual income. The final assumption of this study was that the quantitative research design and *t* tests that were performed were adequate to determine whether a relationship existed between the independent and dependent variables identified in the study.

Scope and Delimitations

This study explored micronutrient deficiencies and the relationship these variables have with stress level and income level in allied health and nursing students at Keiser University in Miami, FL. Though many studies have shown how nutrient deficiencies as a whole affect the body, this study was designed to only quantify micronutrient deficiencies. This study was also based on an assumption that first-year students at Keiser University would only consist of adults aged 18-40; there may have been students who were outside this age range. It was also assumed that the students participating in the study were no longer living with their parents or lacked parental involvement in their nutritional intake, which was not specifically ascertained in this study. No distinction was made in this study concerning the living accomodations or parental involvement in nutrition of the participants. The goal of this study was to measure micronutrient levels in the freshman population of allied health and nursing students at Keiser University's Miami campus.

Potential threats to internal validity in this study included selection bias, reliability of measures and procedures, and order effects. Selection bias could have occurred if the students who volunteered to participate and were highly deficient did not get the chance to participate in the study. Removal of these students could have had an effect on the statistical averages for the study. The threat of reliability of measures and procedures occurs when students do not receive the same instructions for completing the questionnaires. This discrepancy may occur if the researcher fails to relate a vital piece of information about completing the questionnaires to some of the study participants. Lastly, order effects can occur in the study if the student becomes bored and disinterested during the process of completing the questionnaire and either does not complete it, which results in dropout, or does not answer the questions truthfully, which results in an order effect.

Other possible threats to internal validity were instrumentation or human error. There could have been problems with the computers in the Keiser University library where the questionnaires were completed. Human error was possible in compiling data results.

One main threat to external validity was population validity. It is assumed that the results from this study can be generalized to allied health and nursing students. Given the possibility that the population in this study was a mixture of ages, it could be questioned whether a general statement can be made based on freshman students at Keiser University. College students are used frequently in study designs that generalize treatments or effects for the general population. This study involved every effort to have a diverse group of student participants so that the results could be generalizable for the intended population. Gender bias could also have occurred, as studies have shown that female college students are likely to be more health conscious than their male counterparts.

Limitations

As with any research study, there were several limitations during this research. Study limitations included not only being able to verify the manner in which the data were reported, but also being able to collect sufficient data for the specific questions posed in the research study. One limitation that commonly occurs in studies involves obtaining a reasonable sample size. Finding actual students who would be willing to participate in the study and maintain consistency with what needed to be done for the experiment was a factor in completing this research. Another limitation was that controlling effect of participant living status was not specificially identified for the effect of income level. As this was solely a quantitative study, consistency was the key in obtaining clear and concise data for the analysis and interpretation. Aside from obtaining the actual candidates for the study, their honesty about their micronutrient consumption and consistency in the intake of nutrients was very important, as this could have affected the study results greatly.

Significance of the Study

Sound nutritional practices in medical professionals have been linked to increased efficacy and influence on the patients of these professionals (Kushner et al., 2011). Although doctors and medical professionals tend to have healthier nutritional practices than the general population, their diets are still far from ideal (Kushner et al., 2011). This can be attributed to adjustment to the rigors of medical school, which can reduce self-care behaviors (Kushner et al., 2011). The Institue of Medicine (IOM) 2004 report "Improved Medical Education: Enhancing the Behavioral and Social Science Content of Medical School Curriculum" included the importance of self-care and health behavior among physicians and medical students among the high-priority topics for inclusion in medical curricula (IOM, 2004, p. 56). Research has suggested exploration of this phenomenon beyond medical doctors by including allied health and nursing professionals among the targeted groups, because of the potential for positive influence and change of nutritional behavior in this specialized group of professionals. These individuals are aware of or will become aware of both the behavior change theories and the logic of sound nutritional choices and behaviors. This study also has the potential to inform leaders and developers of academic and personal development programs. Specifically, there is potential to develop nutritional and health programs for first-year allied health and nursing students.

Additionally, this study has the potential to provide information that will enlighten the public as to how important it is to obtain all nutrients necessary to maintain a healthy body. The general public may be unaware that micronutrient deficiency contributes to and can cause certain chronic diseases. Ames (2005) used cultured human cells to demonstrate that a deficiency of vitamins C, E, B12, B6, niacin, folic acid, iron, or zinc may mimic radiations that cause lesions to the DNA single-strands and double-strands, which can ultimately lead to cancer (Ames, 2005; Ames & Wakimoto, 2002). These findings indicated that more than half of the US population is susceptible to a deficiency of at least one micronutrient (Ames, 2005; Ames & Wakimoto, 2002).

A good dietary regimen is the most important factor in acquiring and maintaining the micronutrients that are needed for efficient physiological functioning of the body. Vitamin B12 in particular is essential for maintaining blood production as well as a healthy nervous system. Compromising essential micronutrient intake can lead to numerous abnormalities within the body as well as cause major diseases and disorders. Demonstrating that young, healthy adults may have deficiencies in the primary micronutrients could initiate a change in the way public health officials and the medical community as a whole view the importance of a healthy and balanced diet at all ages.

The lack of time in the medical profession can lead to a disregard for the need to eat healthy foods and lack of awareness of personal health. The rush to the cafeteria or fast-food restaurant for access to the first available foods usually results in choosing foods with a lot of calories because of the need to be satiated to work, as well as awareness that the chances of having time to eat again are slim. This behavior opens doors to the modifiable factors that lead to cardiovascular diseases (Yusufet al., 2004). For example, hypertension is associated with bad dietary habits, which may be the principal trigger of complications such as cardiovascular diseases, acute myocardial infarction, and strokes. Another important risk factor is obesity, which is a consequence of eating without pattern, unhealthy diet, and excess of intake with lack of micronutrients. Micronutrients are of concern because they are among the components that are necessary for the metabolic system to work properly. Previous researchers have established that eating fruits and vegetables can reduce the prevalence of heart disease. Normally, when people eat more fruits and vegetables, they are substituting or avoiding an excess of other harmful, less nutritious foods.

Summary

Micronutrients are nutrients that are essential in small quantities for humans to achieve optimal physiological functions. Fabricated foods are made to mimic natural foods but are composed of a collection of ingredients that are rich in the macronutrients protein, carbohydrates, and fats (Kaufman & Palzer, 2011). It is difficult to expect a single food ingredient or condiment to deliver the quantities of micronutrients needed, in contrast to whole fruits and vegetables, which may contain the ideal servings of micronutrients. Therefore, a healthy meal should include vegetables and fruits to acquire the recommended daily allowance of micronutrients (Ronzio, 2003).

There are certain dietary patterns and health risk behaviors that are likely to cause micronutrient deficiencies. A western diet is usually based on large amounts of animal products and low intakes of several micronutrients, compared to those individuals who have a fruit- and vegetable-based diet (Akikusa, Garrick, & Nash, 2003; Levin & Greer, 2000). A meat-based diet has been associated with vitamin C (Levin & Greer, 2000) and vitamin A deficiency (Greene-Finestone, Campbell, Evers, & Gutmanis, 2005). According to Ma et al. (2000), smokers have poorer diets than nonsmoking individuals, and likely to consume fewer fruits and vegetables, and tend to consume more saturated fats (Ma et al., 2000). Nicotine and other toxic substances in cigarettes not only attributed to the adverse effect of cigarette smoking on taste receptors (Ma et al., 2000), but also can block absorption of vitamins and minerals (Northrop-Clewes & Thumhan, 2007). Smoking one cigarette neutralizes approximately 25 mg of ascorbic acid in the human body, which is equivalent to the level of vitamin C in one average-size orange (Northrop-Clewes & Thumhan, 2007). Additionally, it has been found that lower levels of vitamin C in smokers prevent the body from fighting against free radicals, making these individuals more susceptible to diseases (Northrop-Clewes & Thumhan, 2007).

Nutritional deficiency may also result from restricted dietary intakes in those individuals who have or suspect problematic reactions to foods (Fairfield & Fletcher, 2002; Liu et al., 2001) and do not seek alternative sources (Greene-Finestone et al., 2005). According to the Institute of Medicine (2006), U.S. residents obtained less than 40% of the RDA of vitamin A carotenoids. Diets that come from animal products can contribute to many chronic diseases, including cancer (Ames & Wakimoto, 2002; CDC, 2012), when compared to those individuals that have the RDA intake of fruits and vegetables (more than 5 servings per day; IOM, 2000).

The concept of micronutrient deficiencies is one that is fairly simple to understand. *Micronutrients* are defined as basic vitamins and trace minerals that are absorbed and taken in by the body from different foods. Deficiencies of these nutrients, therefore, are typically attributed to insufficient intake of the nutrients, improper supplemental administration, as well as rates of absorption, or lack thereof. Individuals are often told the importance of having a balanced diet, eating healthy foods, and having the right nutrients (Misner, 2006). This research only reinforces that concept. Insufficient intake of nutrients has been proven to result in certain health conditions such as cardiovascular disease, diabetes, and cancer. Micronutrient deficiency has also been linked to compromised immune systems, which can lead to potential opportunistic diseases.

Micronutrient deficiencies are mainly common among the elderly population (Holst-Schumacher, Monge-Rojas, & Barrantes-Santamaria, 2007); however, the research for this study indicated that there is cause to suspect a higher than normal prevalence rate of micronutrient deficiencies in younger, seemingly healthier populations. As such, the sample for this study was chosen from a population of first-year allied health and nursing students.

Healthcare professionals throughout the centuries have acquired more knowledge of the causes of cardiovascular diseases, the relationship between diabetes and diet, and the effects of long-term unhealthy nutrition and its relation to obesity and hypertension, yet cardiovascular diseases and their complications are increasing. The irony is that healthcare professionals are included in these same statistics. Indicators are clear that the inclusion of micronutrients in the diet were a solution to fixing modifiable risk and avoiding cardiovascular disease, yet the decision to include them is personal.

If healthcare professionals put into practice what is proposed in this research study, identifying micronutrient deficiency in the early stages of medical training, this may have a domino effect on patient care and may result in avoiding complications involving not only physical health, but also psychosocial aspects of life. A medical professional's physical presence makes an impact on patients, and the consequences of obesity and diseases in healthcare professionals, without doubt, damages the psychosocial impact that they have on others. Adequate levels of micronutrients in the diet help individuals decrease cholesterol levels, avoid heart diseases, and lower the incidence of hypertension.

Chapter 1 has presented the introduction, statement of the problem, research questions, significance of the study, definition of terms, and limitations of the study. Chapter 2 contains a comprehensive literature review and research exploring the potential effects of inadequate levels of micronutrients. An extensive literature review on micronutrients and micronutrient deficiencies is included in Chapter 2. The general literature review addresses the common micronutrients A, B, B12, C, D, E, K, and folate, and the minerals iron, calcium, and zinc. In addition, Chapter 2 addresses micronutrient deficiencies and the effect of nutritional deficiencies on the body in greater detail. Chapter 2 also gives an in-depth review of each micronutrient and postpositivist theory. The methodology and procedures used to gather data for this research study are presented in Chapter 3. The results of analyses and findings to emerge from the study are contained in Chapter 4. Chapter 5 contains a summary of the study and findings, conclusions drawn from the findings, a discussion, and recommendations for further study.

Chapter 2: Literature Review

Introduction

The purpose of this study was to (1) estimate micronutrient levels in a sample of allied health and nursing students, (2) compare these levels to the recommended daily allowances for these micronutrients, (3) compare the estimated micronutrient levels in students with high income with those of students with low income, and (4) compare the estimated micronutrient levels in students with high stress levels to those of students with low stress levels in a sample of first-year allied health and nursing students. This chapter begins with a description of the research strategy used for the literature review. Following the review strategy, a review of the literature is presented throughout this chapter. The first section provides an introduction and background information on micronutrients followed by the sources of micronutrients, epidemiological data, modes of administration, measures and methods, and a summary of the research.

Literature Search Strategy

A broad search was conducted using the Thoreau search engine to access multiple databases (including Medline [with Full Text], Cochrane Database of Systemic Reviews, and Sage) to explore past research findings connecting micronutrients and vitamin B12 deficiencies with dietary patterns. The majority of the articles used in this review were acquired online from the Walden University Library. Other articles and resources were acquired through Google Scholar and a local library. The following list of terms and Boolean operators were used to identify articles and books relevant to this study: *micronutrient deficiency*, *vitamin B12 deficiency*, *dietary patterns effects*, *vegan diets effects*, *pernicious anemia*, *nutrient clinical trials*, *cobalamin deficiency*, *vitamin B12 and* *memory*, *vitamin B12 and adolescents*, and *administration of micronutrients*. The initial search resulted in 301 articles. A filter for full-text, peer-reviewed articles was conducted, resulting in 170 articles. Next, a preliminary review of the titles and abstracts was conducted to determine relevance to the study, which resulted in a total of 58 full-text, peer-reviewed articles. Finally, while reading each article, I identified additional resources using the reference lists at the end of each article.

Micronutrient Background

Inadequate nutrients may be associated with poor eating habits in allied health and nursing students who are exposed to stress and lack of time. According to Ganasegeran et al. (2012), university students have frequent snacking habits and have higher fast food consumption. These unhealthy behaviors that are temporarily acquired during their university life may persist in older adult life (Ganasegeran et al., 2012; Mikolajczyk, Ansari, & Maxwell, 2009). The Ganasegeran et al. (2012) results showed that most of the students did not have frequent consumption of fruits and water intake. More than 73.5% of the medical students consumed fried food. Mikolajczyk, Ansari, and Maxwell (2009) found in females an association of consumption of sweets, fast food, fruits, and vegetables with perceived stress; consumption of meats, fruits, and vegetables was found to be associated with depressive symptoms. During stress, consumption of salads or vegetables was reported to be less frequent. Interventions oriented toward food intake in female students should include healthy eating, which may contribute to the reduction of stress and depressive symptoms (Mikolajczyk , Ansari, & Maxwell, 2009). Social and psychological factors are determinants of medical students' eating habits. Education on consumption of healthy nutrients should be encouraged in medical students of all levels

(Ganasegeran et al., 2012; Mikolajczyk, Ansari, & Maxwell, 2009). The human body requires nutrients that are commonly divided into two categories, macronutrients and micronutrients (IOM, 2006). The human body generally consumes a larger amount of macronutrients measured in grams such as proteins, carbohydrates, fats, and alcohol. According to IOM (2006), the human body depends on minimal quantities of micronutrients. As mentioned in Chapter 1, micronutrient deficiencies could be attributed to insufficient nutritional intake, inadequate administration of micronutrients, or other contrary absorption rates and biochemical processing (Sriram & Lonchyna, 2009). Allen (2003) provided a detailed explanation of the necessity to understand the causes and impact of micronutrient deficiency in the body in order to decrease adversity. Many authors have acknowledged that insufficient intake of essential vitamins and minerals can result in cardiovascular disease, diabetes, and cancer (Ames, 2006; Black, 2003; Sriram & Lonchyna, 2009).

Micronutrients are available in a wide range of food sources. Iron-rich foods can be found in organ meats and poultry, as well as in dried beans and fruits, nuts, vegetables, whole grain breads, and cereals. Dietary sources of zinc have been found in lean meats, liver, eggs, and seafood. Iodine can be obtained in vegetables that are grown on iodine-rich soils, sea vegetables (seaweed), and seafood (Trumbo et al., 2002; NIH, 2012). The most common source of iodine is iodized salt. The major sources of dietary calcium are dairy products and milk. Other calcium-rich food sources include dark green leafy vegetables: broccoli, legumes, nuts, and whole grains are other calcium-rich food sources (Trumbo et al., 2002; NIH, 2012).

The liver is used for the consumption of iron; it is also a rich source of vitamin A. In addition, vitamin A can be found in kidneys, butter, egg yolk, whole milk, cream, and skim milk. Cod liver oil and halibut fish oil contain high levels of vitamin A. Beta-carotene is found in yellow and dark leafy green vegetables (spinach, carrots, sweet potatoes, squash) and yellow fruits and are another source of vitamin A (Trumbo et al., 2002; NIH, 2012).

Higher income, greater access to a wider variety of micronutrient-rich, fortified food, and better health services are all factors that contribute to decreased risk and prevalence of micronutrient deficiency (Allen, de Benoist, Dary, & Hurrell, 2006). Consumption of a diet that contains a high proportion of energy-dense, but micronutrient-poor processed food can place some population groups at risk for micronutrient deficiency. Although this consumption pattern is more common in industrialized countries, it is rapidly becoming more prevalent among countries undergoing social and economic transition (Allen et al., 2006). The three most common forms of micronutrient deficiencies are iron, vitamin A, and iodine deficiency. The scale and impact of deficiencies in other micronutrients were much more difficult to quantify; however, it is likely that some forms of micronutrient deficiency (i.e., zinc, folate, and vitamin D deficiency) make a substantial contribution to the global burden of disease (Allen et al., 2006). Micronutrients represent important energy elements and are required to keep the body healthy. The human body does not produce many of the needed nutrients; therefore, dietary measures are an essential pathway for receiving micronutrients (Alaball et al., 2005).

According to Bourre (2006), there are some micronutrient deficiencies that can alter cerebral functions. The micronutrients that are closely involved in brain function are vitamins A, B, C, E, and K, including minerals such as iron, copper, zinc, iodine, magnesium, and selenium (Bourre, 2006). Vitamin B1 deficiency is correlated with depression and is induced by the deficiency of vitamin B3. Increase of levels of B6 in the brain may combat asthenia, irritability, and depression. Vitamin B9 (folic acid) has been found to be associated with development of the fetal nervous system during early pregnancy. The deficiency of vitamin B12 (cobalamin) can induce hematological alterations, neurological disorders, and psychiatric disturbances. Vitamin C (ascorbic acid) is necessary for dopamine and noradrenaline transformation. Vitamin D has the ability of protecting neurons found in the hippocampus and facilitates the process of transporting glucose to the brain. Vitamin E protects the brain from aging, and vitamin K has a protective effect in retina aging (Bourre, 2006). Iron is considered to modulate cerebral development. Iron deficiency is associated with a reduction of efficient supply of oxygen to the brain, which decreases brain energy production (Bourre, 2006). Approximately 66%-80% (4-5 billion) of the world’s population may be iron deficient, and more than 30% (2 billion) of the world’s population is anemic (CDC, 2006). Zinc deficiency occurs in one-third of the world’s population (CDC, 2006). Zinc plays a role in cognitive development and takes part in the mechanisms for taste and smell. Deficiency of zinc can involve behavioral changes including depression (Bourre, 2006). One-third of the world’s population experiences illnesses of cerebral functioning and intelligence that may be associated with iodine deficiency (Bourre, 2006). Mental retardation, for example, is one result of iodine deficiency during pregnancy. When the fetus is deprived of iodine, the development of the brain is altered, causing irreversible damage (Bourre, 2006). In addition, the deficiency of iodine can also relate to a 10-15% lower average intellectual quotient (IQ; Bourre, 2006; CDC, 2006).

Micronutrients are used in almost all cells' and enzymes' metabolic functions (Ames, 2006; Saladin, 2012; WHO, 2002). The consumption of a healthy diet with proper nutritional intake and physical activity can reduce risk factors that can later contribute to chronic diseases.

Micronutrients

Vitamin A. Vitamin A is an essential nutrient that is required in small amounts by humans for the normal functioning of the visual system, the maintenance of cell function for growth, epithelial cellular integrity, immune function, and reproduction (Allen et al., 2006; USDA, 2012). Usually, vitamin A deficiency develops in an environment of ecological, social, and economical deprivation. A risk factor for vitamin A deficiency is a diet low in dairy products, eggs, fruits, and vegetables, which results in poor nutritional status and can contribute to infections—in particular, measles and diarrheal diseases (Allen et al., 2006).

Vitamin B. Historically, little attention has been paid to thiamine (vitamin B1), riboflavin (vitamin B2), niacin (vitamin B3), and vitamin B6 vitamins. Lack of reliable information about consequences of marginal or subclinical deficiencies has been the reason why B-complex vitamins have been neglected in the past. Supporting evidence has shown that vitamin B deficiencies are highly prevalent in many developing countries, in particular where diets are low in animal product, fruits, and vegetables, and where cereals are milled prior to consumption (Allen et al., 2006). Pregnant and lactating women, infants, and children have a higher incidence of vitamin B deficiency in developing countries (Allen et al., 2006). Vitamin B1 is found in small concentrations in all plants and animal foods. A dietary source of vitamin B1 is found in whole cereal grains. Dairy products, milk, liver, meats, dark green vegetables, eggs, avocados, oysters, mushrooms, and fish have moderate amounts of vitamin B2.

Vitamin B12. Vitamin B12 (cobalamin) is an essential micronutrient used in red blood development and the maintenance of the nervous system. Vitamin B12, like folate (vitamin B9), is involved in a common metabolic pathway that supplies essential methyl groups for DNA and protein synthesis (Vogel, Dali-Youcef, Kaltenbach, & Andres, 2009). B12 acts as a cofactor for methionine synthase and methylmalonyl-CoA mutase. The Food and Nutrition Board of the Institute of Medicine recommended 2.4 mg/day for adults (Andres, Dali-Youcef, Vogel, Serraj, & Zimmer, 2008). A typical western diet typically exceeds this recommended daily allowance, ranging from 3-30 mg/day. Accordingly, the store of cobalamin in an adult body ranges from 2,000 mg to 5,000 mg, with 80% of this quantity being stored in the liver. Vitamin B12 binds with transcobalamin and haptocorrin. Only 30% of total plasma B12 is bounded to transcobalamin, while haptocorrin consists of approximately 70% of the plasma vitamin B12 (Green, 2008; Herrmann & Obeid, 2008). Transcobalamin is considered to be more functional, as it represents metabolically active B12, while haptocorrin transports the additional amount of vitamin B12 to the liver (Herrmann & Obeid, 2008). According to Lindeman et al. (2000) neither low serum nor normal levels of vitamin B12 are indicators to rule out a deficiency to cobalamin. Cobalamin binds to two different types of transcobalamin, types I and II; 10% to 20% is associated to the transcobalamin II, which is the most functional active component of cobalamin (Vogel et al., 2009). Animal products (eggs, fish, and meats) are the main source of vitamin B12 in adults. Vitamin B12 is absorbed through the gastrointestinal tract; however, the inability of the body to absorb it or inadequate intake of the micronutrient can lead to deficiency.

Vitamin C. Vitamin C is an oxidation-reduction system composed of ascorbic acid and dehydroascorbic acid, and as such, acts as an electron donor. Its main metabolic function is to maintain collagen formation. It is also an important antioxidant. Although severe vitamin C deficiency is now relatively rare, the prevalence of mild or marginal deficiency is probably quite high (Allen et al., 2006).

Vitamin C is found in fresh fruits (citrus fruits, strawberries, cantaloupe, and currants) and vegetables (brussels sprouts, collard greens, lettuce, cabbage, peas, and asparagus; Trumbo et al., 2002; USDA, 2010). Vitamin C is an antioxidant that is needed for growth, healthy body tissue, and the circulatory and immune systems (WHO, 2006).

Vitamin D. Vitamin D, a fat-soluble vitamin obtained from sun exposure and food, is biologically inactive and must undergo two hydroxylations in the body for activation (Misra, Pacaud, Petryk, Collett-Solberg & Kappy, 2008). Vitamin D is first synthesized in the liver, where it converts vitamin D to 25-hydroxyvitamin D [25(OH) D], also known as calcidiol. Then, it continues through the kidney and forms the physiologically active 1, 25-dihydroxyvitamin D [1, 25(OH) 2D], also known as calcitriol (Misra et al., 2008). Furthermore, vitamin D promotes calcium absorption in the intestines and maintains adequate serum calcium and phosphate concentrations to enable normal mineralization of bone and to prevent hypocalcemic tetany (Misra et al., 2008).

Vitamin D is one of the most important regulators of calcium and phosphorous homeostasis (Allen et al., 2006). In addition, it plays several roles in cell differentiation and in the secretion and metabolism of hormones, including parathyroid hormone and insulin. Vitamin D is synthesized in the skin of most animals, including humans, from 7-dehydrocholesterol by the action of sunlight. The global prevalence of vitamin D deficiency is uncertain, but it is likely to be fairly common worldwide, especially among infants, young children, the elderly, and those living at high latitudes where daylight hours are limited in the winter months (Allen et al., 2006).

Vitamin D is essential for the skeletal system and teeth, as well as absorption of calcium in humans. Even though vitamin D is obtained by the consumption of sunlight on the integumentary system, there are some foods that are rich in vitamin D (oily fish, liver, cod liver oil, and dairy products; USDA, 2010; WHO, 2006).

Vitamin E. Vitamin E is found in vegetable oils, wheat germ oil, seeds, nuts, and soybeans. Other sources of vitamin E are leafy greens, brussels sprouts, whole-wheat products, whole grain breads and cereals, avocados, spinach, and asparagus (IOM, 2006; NIH, 2012). Vitamin E is important in cell maintenance and the circulatory system; like vitamin C, it is considered an antioxidant. Foods that are rich in vitamin E include avocados, tomatoes, sweet potatoes, spinach, watercress, brussels sprouts, blackberries, mangoes, salmon, mackerel, nuts, wholegrain products, and oils (sunflower, olive, corn, and safflower; USDA, 2010).

Vitamin K. Vitamin K is synthesized in the intestines. Vitamin K can be obtained from spinach, salad greens, broccoli, brussels sprouts, and cabbage (IOM, 2006; NIH, 2012). According to Shearer and Newman (2008), phylloquinone is a major dietary source of vitamin K found in plant sources. More than 60% of the total of phylloquinone dietary intake in the United States and Europe is obtained from green leafy vegetables (Shearer & Newman, 2008). Vitamin K is involved in clotting factors and maintenance of the skeletal system. Vitamin K can be found in small quantities in meat, various vegetables, and wholegrain cereals (USDA, 2010).

Folate. Folate, vitamin B9, plays a central role in the synthesis and methylation of nucleotides that intervene in cell multiplication and tissue growth, including protein synthesis and metabolism, which closely relates to that of vitamin B12 (Allen et al., 2006). Folic acid (vitamin B9) is synthesized in the intestine. Folic acid can be found in a wide variety of foods, including dark green leafy vegetables, brewer's yeast, liver, eggs, beets, broccoli, brussels sprouts, orange juice, cabbage, cauliflower, cantaloupe, kidney and lima beans, wheat germ, and whole grain cereals and breads. Vitamin B6 (pyridoxine) is synthesized in the intestinal tract. Yeast, wheat germ, organ meats, peanuts, legumes, potatoes, and bananas are vitamin B6 food sources.

Trace Elements

Iron. Iron in the human body is mostly present in erythrocytes as hemoglobin, where its main function is to carry oxygen from the lungs to the tissues (Allen et al., 2006). Iron is also an important component of various enzyme systems, such as the cytochromes, which are involved in oxidative metabolism (Allen et al., 2006; U.S. Department of Agriculture [USDA], 2012). It is stored in the liver as ferritin and as hemosiderin. Iron deficiency is the most common and widespread nutritional disorder in the world (Allen et al., 2006). Iron has become a public health problem in both industrialized and nonindustrialized countries (Allen et al., 2006).

Calcium. Calcium is the most abundant mineral in the body. Calcium is located in the skeleton where it exists as hydroxyapatite and maintains the rigidity and strength of the skeleton. Calcium is involved in a large number of metabolic processes including blood clotting, cell adhesion, muscle contraction, hormone and neurotransmitter release, glycologen metabolism, and cell proliferation, and differentiation (Allen et al., 2006).

Zinc. Zinc is an essential component of a large number of enzymes and plays an important role in cellular growth, immune function, protein synthesis, wound healing, and DNA synthesis (Allen et al., 2006; USDA, 2012). The extent of zinc deficiency worldwide is not well documented. All population age groups are at risk of zinc deficiency, but pregnant and lactating women, infants, and young children are probably the most vulnerable (Allen et al., 2006).

Micronutrient Deficiency

Inadequate dietary intakes of nutrients have been linked to a higher incidence of pathologies such as diabetes, cardiovascular diseases, and cancer. Macronutrients and micronutrients are essential in the human bodies' calorie intake and are required for metabolic functions (Ames, 2006). In the United States, the leading dietary source of energy is based on macronutrients that are abundant in carbohydrates and fats, while deficient on micronutrients (Ames, 2006). Moshfegn, Goldman, and Cleveland (2005) did a comparison report on the national estimates of usual nutrient intake distribution from food and the Dietary Reference Intakes that were published by the Institute of Medicine. Moshfegn et al (2005) found that most Americans had inadequate dietary intakes of vitamin A, vitamin E, and magnesium. In addition, an inadequate intake of foods with vitamin C were found in one-third to more than one-half of the population.

Deficiency in vitamin B6 was more associated in females over the age of 50, while zinc was found in males and females over the age of 70 and females between 14-18 years of age (Ames, 2006; Moshfegn et al., 2005).

Micronutrient deficiencies can lead to chronic metabolic disruption and cause significant degenerative diseases (Ames, 2006). Approximately 56% of adults in the United States have magnesium levels below the Estimated Average Requirement (EAR). Deficiency of magnesium has been found to be associated with colorectal cancer, hypertension, osteoporosis, diabetes, and metabolic syndromes (Ames, 2005).

Another example is seen in people with darker pigmentation of the skin that are indigenous to Southern India, Africa, and other tropical regions are protected from the ultraviolet light exposure from the sun (Ames, 2006). However, dark pigmentation of the skin can interfere with the formation of vitamin D in the skin (Ames, 2006). In addition, African Americans have a higher probability of vitamin D deficiency. Vitamin D deficiency accounts for 29% of cancer mortalities in males such as colon, breast, pancreatic, and prostate cancer (Ames, 2006). Cardiovascular diseases have also been associated with vitamin D deficiency (Ames, 2006; Sriram & Lonchyna, 2009). Multiple sclerosis has also been associated with deficiency of vitamin D and in vitamin B12 (Ames, 2006).

Chronic degenerative diseases have been linked to micronutrient deficiencies. For example, calcium deficiency has been found to have a connection with diabetes and chromosomal breakdown, folate, and vitamin B12 have also been associated with chromosomal breakdown (Ames, 2006). In the United States, iron intake is approximately 16% below the Estimated Average Requirements (ERA) in menstruating women (Moshfegn et al., 2005). Deficiency of iron has also been associated with decreased immune functions and neuromuscular abnormalities. Tables 1 and 2 give more metabolic information and characteristics of causal factors on most common micronutrients, and minerals.

There are multiple causes for vitamin B12 deficiency including low nutritional intake or impaired intestinal absorption (Bamonti et al., 2009). The most common cause of vitamin B12 deficiency is pernicious anemia where "absorption is impaired due to intrinsic factors deficiency arising from autoimmune destruction of parietal cells (Vidal-Alaball et al., 2005, p. 2) and food cobalamin malabsorption (Vogel et al., 2009). Andres et al. (2007) highlights that a patient can have a deficiency for as long as five to 10 years before any manifestations appear. Some additional common causes include gastrectomy, ileal resection, and pancreatic insufficiency. However, there are other causes associated with vitamin B12 deficiency such as drugs like biguanides (metformin), antacids, aminoglycoside antibiotics, colchicines, gastrointestinal bacterial overgrowth, and infestation. Early detection of low levels of vitamin B12 can prevent or prolong many of the known pathological consequences of cobalamin deficiency (Akdal, Yener, & Kurt, 2008).

When vitamin B12 deficiency is found in infants, the main cause is the mother's diets and babies who are breast-fed by mothers who are vegetarians (Incecik, Herguner, Altunbasak, & Leblebisatan, 2010). Since vitamin B12 is not found in plant food, the only source of vitamin B12 in a vegan diet is through the production of certain bacteria's found in the distal portion of the small intestine. It has been demonstrated that mild hyperhomocysteinemia could be a consequence of vitamin B12 deficiency related to alternation of nutrition as seen in vegan and vegetarian diets (Krajčovičová-Kudlačková, Blaźíćek, Kopčová Béderová, & Babinská, 2000). Other research studies have found a relationship between the levels of homocysteine and holotranscobalamin, where malfunctioning of certain organs from the digestive system can cause malabsorption of dietary cobalamin, which results in vitamin B12 deficiency (Woo, Kim, Park, Park, & Han. 2010). Other causes of vitamin B12 deficiency can be related to oral contraceptives (Gardyn, Mittelman, Zlotnik, Sela, & Cohen, 2000).

Vitamin B12 deficiency can lead to high levels of unmetabolized methylmalonic acid and homocysteine. There are signs, symptoms, and clinical manifestations of vitamin B12 deficiency (Ahn, Cho, & Jeon, 2004; Andres et al., 2008; Aziz & Hussein, 2005). Furthermore, Vogel et al. (2009) explained that the diagnosis of vitamin B12 deficiency could be difficult because an individual may present with normal vitamin B serum levels and still have a metabolic deficiency. By the same token, potentially serious neuropsychiatric and hematological clinical manifestation can be so subtle rendering them unrecognizable (Andres et al., 2007, 2008). A great variation of the signs and symptoms supports the label provided by Andres et al. (2007) who entitled the manifestations of vitamin B12 as polymorphic. Further asserting the broad range of severity as noted by the outcomes listed the association of vitamin B12 deficiency and its' related impairments, dates back to 1849 with the original research of Thomas Addison on pernicious anemia (Pearce, 2004). Clinical consequences of cobalamin deficiency may result in megaloblastic anemia (Bamonti et al., 2010). There has also been evidenced that suggests subclinical deficiencies may be more common. The subtleness of a subclinical manifestation contributes to the deficiency being underdiagnosed and unrecognizable (Andres et al., 2007).

Two markers have been identified to measure vitamin B12 levels; holotranscobalamin and serum cobalamin. Both have proven effective; however, holotranscobalamin has been labeled more sensitive. A study designed to evaluate the cut-off threshold, and correlation between holotranscobalamin and other diagnostic parameters, Bamonti et al. (2010) pointed to the analysis of concentrated holotranscobalamin levels as an early detector of vitamin B12 deficiency (Bamonti et al., 2010). There are many other signs and symptoms that may be present in patients suffering from the deficiency like anemia, fatigue, and mood disturbance (Butler et al., 2006). Myocardial infarction and stroke have been linked to vitamin B12 deficiency. Inadequate dietary intake of vitamin B12 can contribute to hematologic (megaloblastic, macrocytic anemia), neurologic (demyelinization, paresthesia), gastrointestinal (anorexia glossitis), and psychiatric symptoms (depression, bioploar disorder, panic disorder psychosis, phobias and dementia; Tufa, Bilici, Usta, & Erdogan, 2012). For example, in a case study reported by Tufa et al. (2012), neuropsychiatric symptoms (mood disorders with psychotic features) were found to be related to vitamin B12 deficiency in a 16 year old male patient.

The neuropsychiatric abnormalities associated with vitamin B12 deficiency are paresthesias (tingling or numbness) impaired vibratory, and proprioceptive sense, ataxia (lack of muscle coordination), urinary or bowel incontinence, impotence, optic atrophy, memory loss, dementia, depression, personality change, hallucinations, and abnormal behavior, most of these clinical manifestations were found in Tufa et al. (2012) case study. It is important to know that neuropsychiatric changes secondary to vitamin B12 deficiency may be partially irreversible even after therapy. Reversible nonspecific symptoms of vitamin B12 deficiency may include weakness, sore tongue, anorexia, diarrhea, skin hyperpigmentation, icterus, and systolic flow murmur. Middlesman et al. (1996) reported that the normal range of serum cobalamin levels found in a patient was 37 pmol/L with hemoglobin of 11.5g/dL and mean corpuscular volume (MCV) of 109-153 fL. The MCV is particularly a measurement of the average red blood cell volume. Since cobalamin can activate methylmadonyl-CoA to succinyl-CoA, the serum andurine of methylmalonic acid levels can be found elevated in patients with vitamin B12 deficiency (Middlesman, et al., 1996).

Vitamin K-dependent coagulation factors are synthesized in the liver, which is thought to be the main site of vitamin K in humans (Shearer & Newman, 2008; USDA, 2012). The estimated excretion of phylloquinone is about 60-70%. Vitamin K is a catabolic product excreted in the bile and urine (Shearer & Newman, 2008). According to Shearer and Newman (2008), there has been only one research study on vitamin K concentration in plasma and liver that has been able to demonstrate how rapidly and severely vitamin K can be exhausted from the tissue and affect tissue storage. In the liver biopsy comparison, the study demonstrated that after three days of low phylloquinone diet intake, the liver only contained 25% of the phylloquinone from a patient's standard diet (Shearer & Newman, 2008).

Vitamin D's role is critical in providing calcium and maintaining pH homeostasis and contributes in the maintenance of the immune system (Lappe, Travers-Gustafson, Davies, Recker, & Heaney, 2007; McGrath, Burne, Feron, Mackay-Sim & Eyles, 2010;

Ramagopalan et al., 2009). Deficiency of vitamin D has been found in multiple sclerosis patients (Ramagopalan et al., 2009), as well as affecting the immune system and development of the lung's physiology (Litonjua, 2009). In a study that was implemented in Costa Rican children with asthma, 28% of the children had lower levels of vitamin D, and other studies showed a high prevalence of vitamin D deficiency in areas that had sun-rich environments (Litonjua, 2009). Pliz, Tomaschitz, Drechsler, Dekker, and März (2010) stated that vitamin D deficiency might be a causal factor for myocardial diseases and reduce cancer risk in postmenopausal women.

Iron is used in the human body, as a component of hemoglobin and carries oxygen for various metabolic functions, especially for nervous system development and cellular function (USDA, 2012). Deficiency of iron can cause anemia (low levels of hemoglobin). However, there are other essential nutrients deficiency such as vitamins A, C, B12, E, folic acid, thiamine, and pyridoxine that can affect the formation of hemoglobin (CDC, 2011). Tables 1 and 2 provide general specification of function, deficiency, and manifestations for vitamins A, B12, D, C, E, K, folic acid, and zinc.

Table 1

Micronutrients

	Role	Deficiency states	Manifestations/clinical signs of malnutrition
Vitamin A Sriram & Lonchyna (2009)	Vision, immune function, and growth; neutrophil function; maintenance of mucosal integrity	High-volume GI losses; steroids; urinary losses × 3 times RDA in pneumonia and sepsis	Poor wound healing, xerophthalmia, mucosal and skin changes, diarrhea. Vitamin A-deficient mucosa does not regenerate adequately which can facilitate bacterial translocation. Bitots spots, Night blindness, poor growth, and hair changes (National Institutes of Health (NIH), 2012)
Vitamin B Khokhar, & Lipman, 2012;NIH, 2012)	Generation of energy from carbohydrates; electron transport chain for citric acid cycle, catabolism of fatty acid; energy transfer reactions in the metabolism of glucose, fat and alcohol; oxidation of fatty acids and carbohydrates; metabolism of amino acids and lipids, proteins; synthesis of neurotransmitters, hemoglobin and gluconeogenesis;	Causes beriberi, disease of the nervous system include weight loss, emotional disturbances, wernicke's encephalopathy (impaired sensory perception), weakness and pain in the limbs, periods of irregular heartbeat, and edema, heart failure and death can occur in advance cases. Korsakoff's syndrome, an irreversible psychosis characterized by amnesia and confabulation. Cheilosis (cracks in the lips), glossitis (inflammation of the tongue), seborrheic dermatitis , pharyngitis (sore throat)	B-1: Fatigue, depression, constipation, edema, enlarged liver, forgetfulness, gastrointestinal disturbances, loss of appetite, and atrophy of muscle tissue, to numbness of the legs, or tingling sensations. B-2: cracking of the lips and corners of the mouth, an inflamed tongue, loss of visual perception and sensitivity to light, cataracts, and burning and / or itching of the eyes, lips mouth, and tongue. Dizziness, hair loss, insomnia, poor digestion, and slowed mental response. B-3: pellagra, dermatitis, dementia, and diarrhea. B-5: fatigue and listlessness, burning foot syndrome is the main characteristic in severe deficiency and include symptoms such as numbness and shooting pains. B-6: depression, convulsion, glucose intolerance, anemia, impaired nerve function, cracked lips and tongue, headaches, hair loss, seborrhea and eczema.

(*table continues*)

	Role	Deficiency states	Manifestations/clinical signs of malnutrition
Vitamin D Sriram, K., & Lonchyna, (2009)	Calcium and bone metabolism. Actually a prohormone; hydroxylated the liver and kidneys to the biologically active $1,25(OH)_2$ form. Receptors are found in several tissues, with unknown functions. Stored in adipose tissues.	Lack of sunlight, elderly individuals, especially with sedentary lifestyles. Ultraviolet B light from sunlight stimulates cutaneous synthesis (UVA light from tanning equipment does not). Hepatic and renal insufficiency; obesity.	Osteomalacia and osteoporosis; immune dysfunction; cardiomyopathy. Serum level of 25-OH vitamin D <11 ng/mL (<27.5 nmol/L), suggestive of deficiency. Muscle aches and weakness (in particular proximal limb girdle), fasciculations (muscle twitching; Khokhar, & Lipman, 2012; NIH, 2012).
Vitamin E Sriram, K., & Lonchyna, (2009)	Antioxidant, important for membrane fluidity and integrity. (Lipid emulsions contain large amounts of vitamin E to ensure stability by protection from peroxidation).	None identified in healthy individuals. May occur in fat malabsorption. Levels decrease with stress. Decrease seen in septic shock occurs in parallel with lipid peroxidation[55] (may represent increased free radical activity).	Peripheral neuropathy, myopathy, and erythrocyte fragility. Neuromuscular problems (spinocerebellar ataxia and myopathies), dysarthria, absence of deep tendon reflexes, loss of vibratory sensation and proprioception, positive Babinski sign, anemia, retinopathy, impairment of immune response, male infertility (Khokhar, & Lipman, 2012; NIH, 2012).
Vitamin K Sriram, K., & Lonchyna, (2009)	Coagulation (production of plasma prothrombin [factor II] and factors VII, IX, and X). Also regulates osteocalcin involved in bone formation.	Normal sources are from diet and bacterial synthesis (altered with antibiotic use). Not stored; deficiencies may occur rapidly.	Increased prothrombin time (may not detect subclinical deficiency states that become pronounced after surgery or resuscitation). Deficiency results a decrease in bone mineral density. Coagulopathy, anemia, bruising, bleeding of gums or nose in both sexes, heavy menstrual bleeding in women (Khokhar, & Lipman, 2012; NIH, 2012).

(*table continues*)

	Role	Deficiency states	Manifestations/clinical signs of malnutrition
Vitamin C Sriram, K., & Lonchyna, (2009)	Nonenzymatic antioxidant; function in collagen synthesis, wound healing, and synthesis of neuro-transmitters; required for the synthesis of carnitine (important for the metabolism of long-chain triglycerides). Unlike most other mammals, humans do not synthesize vitamin C.	Classic deficiency state is scurvy. Previous high intake with abrupt cessation of intake may cause rebound scurvy. Requirements are increase in critical illness, especially trauma and burns.	Peri-follicular petechiae and keratosis; ecchymosis; poor wound healing; gingivitis, glossitis; anemia and fatigue. Brown spots on the skin, spongy gums, and bleeding from all mucous membranes, suppurating wounds, loss of teeth, and eventually death (Khokhar, & Lipman, 2012; NIH, 2012).
Folic acid Sriram, K., & Lonchyna, (2009)	Coenzyme in metabolism of nucleic and amino acids; prevents megaloblastic anemia; involved with homocysteine metabolism (of interest in hypercoagulation states). Folate is absorbed mainly in the jejunum.	EtOH abuse; nitrous oxide exposure, renal replacement therapy, antiepileptic drugs	Macrocytic anemia, fatigue; irritability; atrophic glossitis, skin rash; increase in serum homocysteine levels. Loss of appetite, weight loss, weakness, sore tongue, headaches, heart palpitations, irritability, and behavioral disorders (Khokhar, & Lipman, 2012; NIH, 2012).
Vitamin B_{12} Sriram, K., & Lonchyna, (2009)	Needed for the conversion of methyl folate to tetrahydrofolate, thus affecting DNA synthesis. Serves as a coenzyme in conversion of homocysteine to methionine. Absorbed in terminal ileum.	It takes several months to develop a deficiency state. Occurs in elderly patients (due to atrophic gastritis with lack of intrinsic factor); patients on long-term gastric acid suppression; diseases and resections of terminal ileum (eg, in Crohn's disease); exposure to nitrous oxide.	Macrocytic anemia, neuropathy (gait disturbance, numbness, tingling in extremities), and neuropsychiatric manifestations (loss of memory, dementia, disorientation). Serum homocysteine and methylmalonic acid are decreased in Cbl deficiency. Fatigue, depression, poor memory , mania, and psychosis (Khokhar, & Lipman, 2012; NIH, 2012).

Note. CHO = carbohydrate; EN = enteral nutrition; EtOH = alcohol; GI = gastrointestinal; INH = isonicotinic acid hydrazine; IU = international units; IV = intravenous; MV = multivitamin; PN = parenteral nutrition; RAE = retinol activity equivalents; RDA = Recommended Daily Allowance; UVA = ultraviolet. Sources adapted from “Micronutrient Supplementation in Adult Nutrition Therapy: Practical Consideration,”by K. Sriram & V. A. Lonchyna, 2009, *Journal of Parenteral and Enteral Nutrition, 33*, 548. doi:10.1177/0148607108328470

Table 2

Trace Elements

	Role	Metabolism	Deficiency states	Manifestations/clinical signs of malnutrition
Calcium (Khokhar & Lipman, 2012; NIH, 2012).	Nerve conduction, muscle contraction and blood clotting. Absorbed in the blood to maintain blood calcium level.	Use as exocytosis in neurotransmitter release and muscle contraction. Electrical conduction system of the heart uses calcium as the mineral that depolarized the cell, proliferating the action potential. Cardiac myocyte experience calcium influx, prolonging the action potential and creating a plateau phase of dynamic equilibrium.	Dietary calcium deficiency leads to osteoporosis. Hypocalcemia (low level of calcium in the blood) can occur from medications use for diuretics, medical treatments, or disease processes (renal failure or hypoparathyroidism).	Parathyroid hormone deficiency/malfunction, Vitamin D deficiency, hypermagnesemia, hypomagnesemia. Oral, perioral and acral paresthesias (tingling or pins and needless sensation in and around the mouth, lips, and extremities) Carpopedal and generalized tetany, convulsions, lethargy, poor appetite, and arrhythmia., petechiae. Laryngospasm and cardiac arrhythmias.
Iron (Khokhar, & Lipman, 2012; NIH, 2012).	Use for diverse cellular functions, constant balance between iron uptake, transport, storage, and utilization are required to maintain iron homeostasis.	The intestine is the major site of iron regulation in controlling the uptakes of dietary iron across the brush border and the release of absorbed iron across the basolateral membrane to the circulation. In the intestinal lumen, iron exists in the forms of ferrous and ferric iron salts. Ferric iron becomes insoluble at pH values above 3, ferric irons must be reduced or chelated by amino acids or sugars to be efficiently absorbed.	Chronic bleeding (excessive menstrual bleeding, non-mentrual bleeding, gastrointestinal tract bleeding). Ulcers, hemorrhoids, ulcerative colitis. Laryngological bleeding or respiratory tract.	Anemia, thrombocytosis, elevated platelet count, Plummer-Vinson syndrome, impaired immune function, pagophagia, restless legs syndrome Fatigue, dizziness, pallor, hair loss, irritability, weakness, pica, brittle or grooved nails,

	Role	Metabolism	Deficiency states	Manifestations/clinical signs of malnutrition
Zinc Sriram, K., & Lonchyna, (2009)	Formation of metalloenzymes, RNA conformation, membrane stabilization, and protein metabolism. Metalloenzymes include carbonic anhydrase, alkaline phosphatase, alcohol dehydrogenase, and superoxide dismutase. Role in carbohydrate metabolism, immune system, and wound healing.	Good absorption from the duodenum and jejunum. Absorbed Zn is bound to albumin; 95% is intracellular. Excreted (90%) in feces via bile and pancreatic secretions. Normal urinary Zn loss is low and is increased in burns, trauma, and sepsis.	Excessive GI losses (protracted diarrhea, emesis, high-output fistulas), malabsorption; short bowel syndrome; trauma, burns; alcoholism; pancreatic and renal diseases; high-dose steroids; HIV infection, malignancies; coadministration of ferrous salts with EN. Not lost via dialysis (peritoneal), hemodialysis, or continuous renal replacement therapy.	Skin rash (scaly, hyperpigmented lesions involving elbows and knees, also called acrodermatitis enteropathica), characteristic rash around ala nasi; glucose intolerance; poor wound healing; abnormal hemostasis; immune dysfunction; hair loss; altered taste perception (dysgeusia), altered smell perception; diarrhea; decrease in work capacity of muscles with detrimental effects on respiratory function; worsening hepatic dysfunction. Diarrhea, wasting of body tissues, acne, and can affect eyesight, smell, taste, and memory (Khokhar, & Lipman, 2012; NIH, 2012).

(*table continues*)

Note. AI = average intake; EN = enteral nutrition; EtOH = alcohol; GI = gastrointestinal; GPx = glutathione peroxidase; HIV = human immunodeficiency virus; IV = intravenous; PN = parenteral; MTE = multiple trace elements; RDA = Recommended Daily Allowance; RNA = ribonucleic acid; SC, sele. Sources adapted with permission from "Micronutrient Supplementation in Adult Nutrition Therapy: Practical Consideration," by K. Sriram & V. A. Lonchyna, 2009, *Journal of Parenteral and Enteral Nutrition, 33*, 548. doi:10.1177/0148607108328470

Epidemiology

Incidence and Prevalence of Micronutrients

According to the National Health and Nutrition Examination Survey (NHANES), in 2003-2006, approximately 53% of the United States population used dietary supplements. A research analysis was applied to investigate the usual source intakes of micronutrients (naturally occurring, fortified and enriched, and dietary supplement) and compare the usual intakes to the Dietary Reference intake for United States residents that were more than two years of age according to the NHANES 2003-2006 (Fulgoni et al., 2011). Fulgoni et al. (2011) found a percentage of individuals with total usual nutrient intake and individuals with intake from foods and dietary supplements. Seventy percent of those sampled were found to have vitamin D below the estimated average requirement, as well as vitamin E (60%); calcium (38%); vitamin A (34%); vitamin C (25%); and magnesium (45%). A smaller percentage of the sample was found to have total usual intakes below the estimated average requirements for vitamin B6, and vitamin B12, riboflavin, zinc, folate, iron, thiamin, copper, niacin, and selenium (Fulgoni et al., 2011). According to Fulgoni et al. (2011) without enrichment of fortification and supplementation, the United States population would not achieve the Dietary Reference Intake recommended for micronutrient intake. Torheim, Ferguson, Penrose, and Arimond (2010) conducted a systematic review on studies between 1988 and 2008, which indicated that women living in resource-poor settings in sub-Africa, South and South-East Asia, and Latin America are more prone to have low levels of iron, folate, vitamins A, B6, C, riboflavin, and zinc because of inadequate intakes of multiple micronutrients. In addition, the study establish that micronutrient deficiency was more common among pregnant women than non-pregnant women/non-lactating women (Torheim et al., 2010). The studies concluded that 93% of nonpregnant women/non-lactating women demonstrated that the mean/median intakes of iron, and vitamin B6 ware lower than those studies among pregnant women (78%). In addition, the studies demonstrated that the estimated average required intake of thiamin, and riboflavin were found lower in Asia when compared with Africa and Latin America (Torheim et al., 2010).

Early in the 1920s, iodine deficiency was common in the Great Lakes, Appalachian, and Northwestern regions, and in most of Canada. Prevalence of iodine deficiency in these areas has virtually been reduced because of the introduction of iodized salt treatment. However, approximately 40% of the world's population remains at risk for iodine deficiency and continues to be an important public health problem worldwide (Zimmermann, 2009).

It has been well established that older populations and vegetarians are more prone to developing vitamin B12 deficiency (Butler et al., 2006; Holst-Schumacher et al., 2007). In large-scale community, wide studies like the Framingham study, the prevalence of B12 deficiency was found in 12% of the elderly population. However, when examining the rates among a more frail population, particularly elderly population in institutions, where there are typically more sick and malnourished individuals, the population rate can range between 30% and 40%. While scientifically established in the elderly population, vitamin B12 deficiency is not a rare occurrence. Typically, when examining populations of individuals 60 years and older, about 15% of these subjects experience cobalamin deficiency (Andres et al., 2003).

Most studies conducted on the link between vitamin B12 deficiency and the associated effects have focused on a heterogeneous population (Vogel et al., 2009). Prevalence of vitamin B12 deficiency varies by gender, ethnicity, and age. Increased age is correlated with the prevalence of vitamin B12 deficiency. However inconsistencies in the prevalence rates identified have been attributed to differences in diagnostic criteria for vitamin B12 deficiency (Vidal-Alaball et al., 2005). The Barmonti et al. (2010) study evaluated the most adequate cut-off range for holotranscobalamin (range from 35 to 45 pmol/L) to identify vitamin B12 deficiency. While the prevalence of vitamin B12 deficiency is higher in the elderly populations, Holst-Schumacher et al. (2007) found a prevalence rate of 61.2% in a sample of Costa Ricans aged 20-40. In this study, 42% of the “study participants presented either a (11.2%) deficiency or marginal levels (31.2%) of serum vitamin B12” (Barmonti et al., 2012, p. 398). Another study had a sample of 10 healthy women aged 24-34 (Gardyn et al., 2000). This study focused on determining the relationship between low vitamin B12 levels and women who use oral contraceptives. According to Gardyn et al. (2000), 60% of the women demonstrated low serum levels of transcobalamin I (carriers of protein that bind to vitamin B12). The cessation of oral contraceptives for 1-month resulted in returning the levels of vitamin B12 serum to normal range (Gardyn et al., 2000).

Fakhrzadeh et al. (2006) set out to explore the prevalence of total homocysteine, folate, and vitamin B12 in a sample of 1,214 healthy Iranian men and women. In this cross-sectional study, the mean serum of vitamin B12 levels were higher in males (73.1 %) than women (41.0%; Fakhrzadeh et al., 2006). In Addition, the age adjusted prevelence of hyperhomocysteinemia, low folate, and vitamin B12 was found higher than other communities (Fakhrzadeh et al., 2006).

Theoretical Framework

The postpositivist paradigm was used as a foundation for inquiry in this research study. Babbie (2002) explained that research paradigms or worldviews provide a frame of reference to organize what the researcher observes and how the researcher makes sense of the observation. A historical analysis of epidemiology highlights its growth out of public health and primarily focuses on causal factors of disease in populations.

The postpositivist framework stems from the philosophy of the positivists. The positivists believed that the purpose of science is simply to adhere to what can be observed and measured (Trochim & Donnelly, 2009). Science, as believed by the positivists, is a mechanism that allowed for the prediction and control of items, systems, and events of the natural world. The scientific approach of one of the earliest positivists, Comte, suggested that science should be rational and objective (Babbie, 2010). Ulin et al. (2005) suggested that the history and foundation of population research is rooted in the principles of positivist philosophy. This assertion is supported by the quantitative methods used in population research linked to morbidity and mortality studies, as well as epidemiological surveillance techniques (Ulin et al., 2005).

Although many principles underlining positivism and postpositivism are the same, there are subtle differences between the two. For example, Trochim and Donnelly (2009) explained that postpositivism infers a practical approach to science. It is this practicality that allows researchers to recognize the imperfection of the search for knowledge, as well as the results. However, the goal is to “develop the most objective methods possible to get to the closest approximation of reality” (Ulin et al., 2005, p. 15).

Quantitative research has also provided a foundation for population research (Ulin et al., 2005). There are three primary goals at the root of quantitative research using the positivist philosophy (a) to explain a phenomenon, (b) to verify something, and (c) to predict human behavior through causal or associative relationships. This study aimed to verify or disprove the research hypotheses outlined in the following section. In a similar manner to previous quantitative research using the positivist paradigm, this study used prestructured data collection methods with controlled measurements. The goal of this research was to conduct an objective study through the use of a survey using precisely worded questions and statistical analysis as suggested by Ulin et al. (2005).

Comparative Studies on Micronutrient Deficiency

Micronutrients are essential nutrients for cell, tissue, organ maintenance, and assist in the process of the proteins, carbohydrates, and fats that are required for carbon dioxide and oxygen formation in respiration (Saladin, 2012). They are obtained with food intake, and some are obtained by other sources in the human body. Hydrophobic (fat-soluble) micronutrients (vitamin B and vitamin C) are absorbed through the intestinal tract with the assistance of lipids. On the other hand, hydrophilic (water-soluble) micronutrients (vitamin A, D, E, and K) are excreted through the urinary system. For example, vitamin K and biotin is produced in the intestine tract, while vitamin D is synthesized through the epidermis with the assistance of ultraviolet sunlight (Ames, 2006; Saladin, 2012; Sriram & Lonchyna, 2009).

Micronutrients and mineral levels can be measured in food products and monitoring regulatory intake of such food fortification (Ames, 2006; WHO, 2012). Biochemical indicators are used to assess micronutrients and mineral status in populations (WHO, 2012). The assessments that are used for measurements of micronutrient and mineral deficiencies include hemoglobin concentrations, serum ferritin, serum retinol, erythrocyte protoporphyrin concentration, urinary iodine, serum/plasma zinc concentration, serum/plasma folate concentration, serum/plasma vitamin C concentration, urinary thiamine, and measuring erythrocyte transketolase concentrations (WHO, 2012). Hemoglobin concentrations are used in the diagnosis and the assessment of the severity of anemia (WHO, 2012). Urinary iodine (UI) concentration, goiter rate, serum Thyroid Stimulating Hormone, and serum Thyroglobulin (Tg) are criteria that are recommended in assessing iodine nutrition in populations. The UI concentration is a sensitive indicator in the intake of iodine in days since more than 90% of the dietary iodine is found in urine. The serum Tg is an indicator that shows the response of iodine in weeks to month's intake levels while the goiter rate reflects months to year's iodine nutrient (Zimmermann, 2009). The World Health Organization (2012) further uses UI concentrations measure to assess the prevalence and severity of iodine deficiency in populations. Serum and plasma concentrations of zinc, folate, and vitamin C are used to assess the prevalence and deficiency of each. Dose response, repletion, and depletion studies are considered validated biomarker by various researchers as the ideal approach to micronutrients measures (Hooper, Ashton, Harvey, Decsi, & Fairweather-Tait, 2009). Laboratory test performed by serum analysis using standardized values are available to defining normal and deficiency levels of micronutrients.

The Dietary Recommended Nutrient Intake and the RDA was defined in the United States in 1941 " to serve as a goal for good nutrition" (pg. S6-S7) for the general population (Roman-Vinas, Serra-Majem, Ribas-Barba, Ngo, Garcia-Alvarez, et al., 2009). Numerous epidemiologic studies use personal interviews, self-administered questionnaires, or mixed methods (quantitative and qualitative) to obtain information on micronutrients in a selected sample populations (Satia-Abouta, Patterson, King, Stratton, et al., 2003). Additional measures in determining vitamin B12 levels have been recommended to be included in the universal guidelines (Chui et al., 2001). Vogel et al. (2009) suggested that blood samples collection from fasting subjects provide an accurate assessment of the metabolic status for vitamin B12. However, the subjects should have a light meal the evening prior to blood collection. Even in cases where the traditional guidelines are the norm, they are not followed consistently, which suggest that the rates that have been highlighted may be an underestimation of the true pernicious anemia rates in some populations (Chui et al., 2001). Related to the inconsistent use of guidelines, Carmel (2008) spoke of the inconsistency in follow up and treatment of patients with B12 deficiency. Carmel (2008) cautions that "premature medicalization of isolated, mild biochemical changes" (p. 2214). Aziz and Hussein (2005) employed a multiple phase assessment of vitamin B12 content in foods by using three 24-hour dietary recall processes in a study of 62 lactating mothers. According to Herrman and Obeid (2008), treatment for vitamin B12 deficiency depends on what is causing the deficiency. In a randomized study, Vidal-Alaball et al. (2005) compared the administration of intramuscular with oral supplements of vitamin B12 by using 1 mg and 2 mg as a daily treatment, which then was administrated in a weekly dose and later monthly.

To measure mild preclinical vitamin B12 deficiency, the focus goes beyond the levels of vitamin B12 in the blood serum. Andres et al. (2007) recommended that in addition to serum blood levels, that the patient's homocysteine and methylmalonic acid levels should be assessed; both of these additional tests tend to be more accurate assessments of cobalamin deficiency. Another method that has been recommended involves the measurements of the levels of holotranscobalamin (holoTC; Woo et al., 2010).

According to Mikolajczyk et al. (2009) further interventions should be applied in the effort of reducing depressive symptoms, stress, and healthy nutrition among female students. Mikolajczyk et al. (2009) study demonstrated that there are certain foods that are more frequently eaten under stress, or depressive symptoms in females. For example, consumption of sweets/fast foods was associated with perceived stress in females students, while depressive symptoms was associated with less comsumption of fruits/vegetables, and meats. Depressive symptoms and perceived stress was not association in male students. Mikolajczyk et al. (2009) obtained each students stress levels scores by using the Perceived Stress Scale (PSS) and compared the results with the food frequency questionnaire. The PSS is a 14-item self-report designed to assess "the degree to which situations in one's life are appraised as stressful" (Cohen, Kamarck, & Mermelstein, 1983, p.385). The questions are designed to measure the "unpredictable, ucontrollable, and overloading" (Cohen et al., 1983) of how lifes is perceived. Each item is rated on a 5-point Likert-type scale ranging from 0 being "never" to 4 being "very often" (Cohen et al., 1983). The PSS was intended to be use with community samples of adolescents or adults with an educational level of junior high school or more.

Micronutrient Sustainment Roles

Vitamin A role. Vitamin A plays a role in vision, gene transcription, immune function, embryonic development and reproduction, bone metabolism, hematopoiesis, skin and cellular health, and antioxidant activity throughout the body (Combs, 2008; Duester, 2008; Tanumihardjo, 2011; Wolf, 2001).

Vitamin B role. Vitamin B is also know as B-complex (B1, B2, B3, B5, B6, B7, B9, B12). B vitamins major role are found in the activities of enzymes, proteins that regulate chemical reactions in the body which are essential in the process of digestions and metabolic functions (Fitzpatrick et al. 2012). In females vitamin B1 and B6 has been shown in reducing pain from menstrual cramps (Hamrick & Counts, 2008). The B-complex vitamins are obtained from dietary intake and are required for optimal brain functioning and the production of neurotransmitters (Herbison et al. 2012). Low B-complex (Folate, vitmains B6, B12) in adults has been related with internalizing behavioural problems such as depression (Herbison et al. 2012). Herbison et al. (2012) describe internalizing behavioral as withdrawn, somatic complaints, anxious/depressed behaviors while externalizing behavioral as aggressive/delinquent behaviors. Low intake of B-complex (vitamin B1, B2, B5, B6, and folate) may be assoicated to externalizing problems in adolescents. Furthermore, externalizing problems developed during adolescence may be related to a higher risk of offending and substance abuse later in life (Herbison et al. 2012). According to Friso, Lotto, Corrocher, and Choi (2012), studies have suggested that low dietary intake or reduced blood concentrations of vitamin B6 may be associated with an increased risk of cardiovascular disease (Friso et al., 2012).

Vitamin B12 role. Given the effect of B12 deficiency on memory, fatigue, mood disturbance, and other complications, researchers have begun to examine the prevalence of vitamin B12 deficiency in younger and seemingly healthier populations (Holst-Schumacher et al., 2007). While in the scientific arena there is a consensus that oral and intramuscular supplement have equal efficacy for a range of issues, current clinical practice leans towards the prescription of intramuscular administration (Butler et al., 2006). Researchers have used different methodological approaches to explore vitamin B12 deficiency. For example, Kwong, Carr, Dhalla, Tom-Kun, and Upshur (2005) used a mixed-methods approach to explore patient perspectives on switching from injection to oral supplements. Butler et al. (2006) conducted a systematic review of randomized controlled trial to study the effectiveness of oral versus intramuscular while, Holst-Schumacher et al. (2007) used a cross-sectional survey to study the prevalence of serum vitamin B12 deficiency. Depending on the focus, both quantitative and qualitative methods have been effectively used to explore issues related to vitamin B12 deficiency (Akdal et al., 2008; Holst-Schumacher et al., 2007). Coupled with this is the fact that many scientists use different measures to define vitamin B12 deficiency (serum levels, dietary intakes), define and assess cognitive impairment, and addition study design elements.

Credited with the original work on vitamin B12 deficiency, Addison, Yener, and Kurt (2008) used qualitative methods to present a case study of a patient experiencing prominent executive and behavior dysfunction. In addition to other symptoms, the 58 year old male patient presented with serum vitamin B12 <100 pg/mL and suffered from memory problems. The patient showed improvement on the Mini-Mental State

Examination and on the Neuropsychiatric Inventory after receiving two stages of vitamin B12 therapy (Addison, Yener, & Kurt, 2008). Holst-Schumacher et al. (2007) conducted a cross-sectional survey of 400 adults to determine the prevalence of serum vitamin B12 in a sample of Costa Rican young adults. In 2010, Bamonti et al. (2010) explored cut-off points for identifying cobalamin deficiency using a new immunoenzymatic method for holo transcobalamin (holoTC).

Given the presence of vitamin B12 deficiency in the elderly, many study samples were pulled from a generally older population. However, while vitamin B12 deficiency is more likely to occur in older populations, in some cases infants have presented with vitamin B12 deficiency (Incecik et al., 2010). Typically vitamin B12 deficiency in breastfed infants is a result of deficiency in the mother's diet (Aziz & Hussein, 2005). In a recent case series of 15 breastfed infants who presented with vitamin B12 deficiency, Incecik et al. (2010) highlighted inadequate consumption of animal products by all the mothers in the study. Incecik et al. (2010) reported that after being diagnosed with megaloblastic anemia, "blood values in all cases had improved by the second week of treatment" (p. 18). These results were promising because early and sufficient treatment of vitamin B12 deficiency can prevent and halt further neurological damage in infants (Incecik et al., 2010).

Another approach of exploring past research on vitamin B12 deficiency is through systematic reviews. Vogel et al. (2009) explored cross-sectional, longitudinal and nutrient exposure and intervention studies related to homocysteine, vitamin B12, folate and cognitive functions. Vogel et al. (2009) concluded that only a few studies evaluated the cognitive benefits of vitamin B12. Even among the six studies the results were mixed with two resulting in worsening cognitive functions. However, there was significant variation in dose and administration routes of vitamin B12, the duration of supplementation, the cognitive function assessment instruments used, as well as the sample sizes and duration (Vogel et al., 2009).

In 2009, the Cochran Collaboration conducted a review of randomized controlled trials that examined the use of oral versus intramuscular vitamin B12 to treat vitamin B12 deficiency (Vidal-Alaball et al., 2005). This systematic review examined a series of primary and secondary outcomes that included the following:

- Serum vitamin B12 levels;
- Clinical signs and symptoms of vitamin B12 deficiency (e.g., depressing, tiredness, paralysis, dementia);
- Total homocysteine and serum methylmalonic acid levels;
- Cost;
- Quality of life (ideally measured with a validated instrument).

The two studies that met the inclusion criteria, compared oral versus intramuscular administration. In both studies, the researchers found supporting evidence that oral administration was just as effective. The sample population for this study was older (mean age range: 60-72). The authors concluded that further research was a need to determine whether oral vitamin B12 is effective in patients with common cases of malabsorption and to provide additional evidence regarding cost effectiveness. Additionally, the authors alluded to the psychotropic effects of getting patients to convert from intramuscular administration to oral administration once the serum of vitamin B12 levels were normalized (Vidal-Alaball et al. 2005).

Some studies have used a more focused view of vitamin B12 deficiency and how to address it. Andres et al. (2003) explored vitamin B12 deficiency as a result of food malabsorption. A prospective study of 30 patients with vitamin B12 deficiency and their response to oral treatment was conducted between 1995 and 2002. Twenty-six of the 30 patients that were treated with oral crystalline cyanocobalamin displayed normalized levels after 1 month of treatment. While the patients in this study responded favorably, the dosage ranged from 250 to 1000 mg of crystalline cyanocobalamin per day. This fact adds to the ambiguity of oral dosage (vitamin B12) needed to effectively address deficiencies (Andres et al., 2003).

Many scientists have made recommendations on how to strengthen future research on cognitive performance and the B vitamins. For example, Calvaresi and Bryan (2001) suggested control for extraneous variables like smoking, which may have nutritional effects. Additionally, making sure that the samples size had significant strength since some of the effects may be subtle and undetectable without sufficient numbers (Calvaresi & Bryan, 2001).

Cravens and Nashelsky (2007) described the different approaches that can be used to evaluate low to normal vitamin B12 levels, which is particularly relevant for the level focused on the research study. The suggested measures were serum methylmalonic acid and homocysteine levels. This recommendation received a “B” as a score for the strength of the recommendation. The definition of low, was defined as 150 to 350 pg/mL. Significant recommendations were suggested from Eastley et al. (2000), which all patients with cognitive impairment should be investigated for vitamin B12 deficiency

(Eastley et al., 2000). This recommendation supports the logic of using the memory test as an initial screening level for the research.

Vitamin C role. Vitamin C is also known as ascorbate and it is essential for various metabolic reactions such as antioxidant, pro-oxidant, antihistamine, and interacts with the immune system (Johnston, Martin, & Cai, 1992; McGregor & Biesalski, 2006; Watson, Zibadi, & Preedy, 2010). The therapeutic method for vitamin C has been effective in preventing or treatment of the common cold (Helmer, Hart, Martin, & Rubio-Wallace, 2009). According to Hemilä and Chalker (2013), daily intake of vitamin C supplements does not reduce the incidence or severity of the common cold, although it may reduce the duration of illness. Vitamin C has been useful in lowering serum uric acid levels, lower incidence of gout, and the prevention or treatment of of pneumonia (Choi, Gao, & Curhan, 2009; Hemilä & Louhiala, 2007). Vitamin C supplementation has been used as a therapeutic effect to reduce the incidence and duration of pneumonia (Hamrick & Counts, 2008).

Myint et al. (2008) research study demonstrated a relation between baseline plasma vitamin C concentrations and future stroke risk in British participants in the European Prospective investigation into Cancer Norfolk. Myint et al. (2008) also found that levels of plasma vitamin C concentrations may contribute with reduced stroke risk and identifying those patients with high risk to a stroke.

Vitamin D role. According to to the data extracted from the National Health and Nutrition Examination Survey, has demonstrated that more than 90% of the pigmented populace of the United States (Black, Hispanics, and Asians) suffer from inadequate levels of 25-hydroxyvitamin D <30 ng/ml. Approximately three-fourth of the white population also suffer inadequate levels of vitamin D (Adams & Hewison, 2010). Adverse outcomes associated with inadequate levels of vitamin D have been found in the muscleskeletal system, microbial diseases, cardiovascular diseases, cancer, and metabolic diseases. For example, factors that contribute in the correction of most rachitic syndromes (soft bones and muscle weakness) in men has been assoicated with the increased sunlight exposure (Adams & Hewison, 2010). According to the Women's Health Initiative, for every 20 ng/ml decrease in the serum levels of 25-hydroxyvitamin D there is a significate increase risk for hip fractures (Adams & Hewison, 2010).

Vitamin D monokine system is necessary in the generation of antimicrobial peptides by monocyte-macrophages. Low levels of serum of 25-hydroxyvitamin D can limit the activations of of antimicrobial genes that assist in killing of ingested microbe (Adams & Hewison, 2010). Furthermore, low levels of of 25-hydroxyvitamin D has been associated to colon cancer and cardiovascular disease (coronary artery diseases, heart failure, and peripheral artery disease) mortalities in the United States (Adams & Hewison, 2010). Metabolic syndromes such as hypertension, obesity, insulin resistance and glucose intolerance has been assoicated to low levels of 25-hydroxyvitamin D (Adams & Hewison, 2010; Clifford et al. 2012).

Vitamin E role. Vitamin E is fat-soluble antioxidant vitamin that helps protect the body from the effects of free radicals (Azzi, 2007; Traber &, Stevens, 2011). Free radicals are substances that can cause cellular damage and increase risks for cardiovascular diseases and cancer. Since vitamin E needs dietary fat to be absorbed, deficiency of vitamin E is diagnosed in individuals that lack fat absorption (Traber & Stevens, 2011).

Vitamin E has various biological functions such as antioxidant being the most important, enzymatic activity regulator, gene expression which are responsible for the repair of wounds, and regeneration of the extracellular tissue lost or damage (Villacorta, Garca-Souza, Ricciarelli, Zingg, & Azzi, 2003). In addition, vitamin E plays a role in nuerological functions (Muller, 2010), and inhibition of platelet aggregation (Atkinson, Epand, & Epand, 2008; Brigelius-Flohe & Davies, 2007). Vitamin E also protects lipids and prevents the oxidation of polyunsaturated fatty acids (Whitney, Whitney & Rolfes, 2011).

Vitamin E supplementation was thought to have positive effects on health, research studies have demonstrated that it does not have an effect in decreasing mortality in adults (Abner, Schmitt, Mendiondo, Marcum & Krvscio, 2011). According to Bjelakovic, Nikolova, Gluud, Simonetti, and Gluud (2012), vitamin A, beta-carotene, and vitamin E may have an increase of mortality. Abner et al. (2011) reported that vitamin E does not improve the levels of blood glucose in patients with diabetes mellitus or decrease the risk of a stroke (Bin, Hu, Cao, & Gao, 2011).

Vitamin K role. Vitamin K is also know as phylloquinone, phytomenadione, or phytonadione. Vitamin K is a fat-solubale vitamin that the human body needs for posttranslational modification of certain proteins required for blood coagulation, and in metabolic pathways in bone and other tissue (Linus Pauling Institute, 2011; Vermeer, 2012). There are several subtypes of vitamin K (menatetrenone (MK4) and menaquinone-7 (MK7). Menaquinone-7 (MK7) is not produced by human tissue and consumption has been demonstrated to reduce the risk of bone fractures and cardiovascular disorders (Pucaj, Rasmussen, Moller, & Preston, 2011; Vermeer, 2012).

According to Shearer and Newman (2008), several studies have demonstrated that vitamin K can inhibit the growth of certain types of cancer cells involving hepatocellular carcinomas, gastrointestinal tumors, and some leukemia cells.

Trace Elements Sustainment Roles

Iron role. Iron is one of the most important trace minerals in the human body and essential for normal function such as cofactor acitivities in the metabolism, and immune system (Ganz & Nemeth, 2012). According to Saunders, Baines, and Posen (2012) there are three levels of iron deficiency (depleted iron stores, early functional iron deficiency, and iron deficiency anemia). In a cross-sectional study that was implemented in 100 medical students, 32% of the students were anemic, out of which 44% were females, and 20% were males (Rubeena, Anand, & Nadeem, 2012). According to Rubeena et al. (2012) nutritional anemia is prevalent and undiagnosed among students in professional institutes. Nutritional anemia is preventable by educating students in eating a well balanced diet rich in green leafy vegetables and fruits (Rubeena et al. 2012).

Calcium role. Calcium must be ingested and abosorbed to function as an indispensible constituent of diverse physiological processes such as bone formation, muscle contraction, neurotransmission, blood coagulation, ezyme activation and hormone secretion (Christakos, 2012).

Zinc role. The human body needs zinc to metabolize carbohydrates, fats, proteins to synthesize DNA and RNA to boost the immune system, support growth, development during pregnancy and childhood (Gamal El-Din, Hassan, El-Behairy & Mohamed, 2012).

Folate role. The risk of several congenital malformations such as neural tube defects can significatly be reduced when consuming folic acid supplementation. Inadequate levels of folate during pregnancy can also increase the risk of preterm delivery, infant low birth weight, and fetal growth retardation, as well as increasing the levels of homocysteine in blood (Scholl, & Johnson, 2000). Increase levels of homcysteine in blood can lead to spontaneous abortion, and pregnancy complications (pre-eclampsia and placenta abruption). The Recommended Daily Allowance for pregnant women is 600 μg, and non-pregnant women is 400 μg of synthetic folic acid daily from fortified foods, and/or supplements with folic acid. Folic acid may reduce chromosomal defects in sperm production in males. Folic acid has also been associated to play an important role in regulating homocysteine concentration, which appears to reduce the risk of stroke (Terwecoren, Steen, Benoit, Boon, & Hemelsoet, 2009). In addition, folic acid was related to decreasing the risk of esophageal, stomach, colorectal, breast, and ovarian cancers (Kim, 2004; Kim, 2006; Sanjoaquin, Allen, Couto, Roddam, & Key, 2005). Prenatal supplementation of multivitamins containing folic acid are associated to decrease the risk of several childhood cancers such as leukemia (39%), neuroblastoma (47%), and brain tumors (27%; Goh, Bollano, Enarson, & Koren, 2007; Hamrick & Counts, 2008).

Risk Factors

According to the Roger et al. (2011) more than one in 3 Americans have been diagnosed with more than one type of cardiovascular disease (heart disease, coronary heart disease, and hypertension), which accounts for approximately 82.6 million American adults (2011). Sodium is considered an essential mineral that is needed for daily functions of our body systems. High levels of sodium in the body contributes to hypertension and can lead to cardiovascular diseases (Roger et al., 2011; U.S. Department of Agriculture (USDA) & U.S. Department of Health and Human Services [HHS], 2010). Vitamin B12 deficiency can have many negative health consequences. The neurological and pathological effects of vitamin B12 deficiency have been documented in numerous clinical studies (Bamonti et al., 2010). Bamonti et al. (2010) highlighted cardiovascular disease, dementia, and neuropsychiatric disorder as pathological complications of vitamin B12 deficiency.

Vaginal infections have been associated to vitamin D deficiency. Bacterial vaginosis is the most common vaginal infection in women of childbearing age. Although this type of infection can be treated with antibiotics, it can lead to premature birth and is a major cause of infant mortality (Bodnar, Krohn, and Simhan, 2009). Bodnar et al. (2009) research study demonstrated that more than half of the women with vitamin D levels below 37 nmol/L were found to have bacterial vaginosis; 52% of the black women had bacterial vaginosis, while only 27% was found in white women. Misra et al. (2008), reported some studies suggest that vitamin D concentration levels of $>$ 75 nmol/L (30 ng /ml) may protect against colon cancer, and perhaps even cancers of the prostate, and breast cancer. In addition, Misra et al. (2008) determined adequate levels of vitamin D may reduce risks of bipolar disorders, while low maternal vitamin D levels may have some type of influence on fetal brain development.

In a prevalence dietary assessment study of vitamin B12 in lactating mothers, reported that only 25.8% were within the averaged intake amounts (4.17 ± 0.74 µg/d) of vitamin B12, while three quarters of the studied population were consuming vitamin B12 less than 2.5 µg/d. The research demonstrated that low maternal dietary levels of vitamin B12 may be a risk factor to breastfed infants, since it can result in permanent effects to brain development caused by the prolonged duration of vitamin B12 deficiency in infants (Aziz, S.A. & Hussein, L., 2005).

Modes of Administration

Different modes of administrating micronutrients have been used to maintain the recommended consumption from healthy to chronic deficiencies. Recently, there has been a shift in the literature to explore the feasibility of oral or nasal modes of administration. The use of intramuscular injections has proven effective and the added benefits of other routes to administer micronutrients (prevention of discomfort, convenience and decreased cost; Andres et al., 2008). For example, in developing countries vitamin B12 is given in the form of cyanocobalamin or hydroxcobalamin intramuscular injections. In the United States, the treatment of intramuscular injection for vitamin B12 deficiency is given in a daily dose of 1000 µg cyanocobalamin for the first week, followed by once a week injections for the second month, and thereafter once a month. In Denmark, the same form and dosage of cyanocobalamin with a regimen of once a week injection for one month, followed every other 3 months, or hydroxcobalamin every 2 months (Hvas & Nexo, 2006). According to Hvas and Nexo (2006), there are various studies that have demonstrated in their research that oral vitamin B12 in a daily dose of 100 µg can maintain normal levels of vitamin B12. Hvas and Nexo (2006) further states that the oral treatment of B12 has not been adequately addressed in individuals with neurological manifestations. Vitamin oral therapy has never been the course of study in a control research study, which has led researchers to conduct a randomized control study using oral and intramuscular cyanocobalamin therapy in patients with cobalamin deficiency (Kuzminski et al., 1998). Studies have demonstrated that oral and intramuscular treatment may have effective neurologic, hematologic, and metabolic responses. Oral therapy with 2,000 µg per day has obtained higher levels of serum concentration than those that receive an intramuscular regimen of nine 1, 000 µg injections over a 4 month period. Oral therapy effectiveness can increase the serum levels of cobalamin deficiency in individuals, but intramuscular therapy will continue to be the preferred method of treatment to hospitalized patients, and patients with vomiting, diarrhea symptoms, or patients not able to take oral medications (Kuzminski, Del Giacco, Allen, Stabler, & Lindenbaum, 1998).

In the United States, intramuscular therapy is the preferred method, as opposed to countries like Canada, and Sweden where oral vitamin B12 therapy accounts for about 73% of vitamin B12 prescribed. In addition to the individual level therapy, some population level interventions have been used to increase vitamin B12 levels. Cordero et al. (2008), explored population-based programs designed to increase the consumption of folates, and vitamin B12. Three population-based interventions were found to include dietary diversification supplementation, and fortification. The results of these programs showed reduced folate deficiency in the target population, increased levels of serum and red blood cell folate, and other positive results. While the evidence to support these programs is strong, public health officials face challenges in determining which intervention to use and if a mix is needed to determine the right configuration (Cordero, Do & Berry, 2008).

Micronutrients are essential for metabolic roles that involve cellular immunity, wound healing, and antioxidant functions. The susceptibility to micronutrient deficiency is commonly found to be associated in chronically ill patients with preexisting conditions (Sriram & Lonchyna, 2009). It has been documented that some medical conditions can contribute to reduction of the serum levels of various micronutrients and minerals. Patients with inflammatory responses can have decreased levels of micronutrients (vitamins A, C, and E), while patients with septicemia have high levels of vitamin A excretion in urine. On the other hand, it has been demonstrated that lower levels of minerals (i.e., iron) may protect the human body from bacterial infections (Sriram &Lonchyna, 2009). Sriram and Lonchyna (2009) recommend supplemental micronutrients in nutrient therapy. Table 3 provides a standard parenteral, and enteral nutrition dose of micronutrients (vitamins A, C, E, K) and minerals (zinc, selenium, and iron).

Table 3

Recommendations for Micronutrients in Critical Illness

		Standard dose	
Micronutrient recommendations	Recommended Daily Allowance	Parenteral formula	Enteral formula
Vitamin A	1 mg	1 mg	0.9-1.0 mg/L
Vitamin C	75-90 mg	200 mg	125-250 mg/L
Vitamin E	15 mg	10 mg	25-50 mg/L
Vitamin K	150 µg	150 µg	40-135 µg/L
Zinc	15 mg	2.5-5 mg	11-19 mg/L
Selenium	50-100 µg	20-60 µg	20-70 µg/L
Iron	10-15 mg	0	12-20 mg/L

Note. Sources adapted from “Micronutrient Supplementation in Adult Nutrition Therapy: Practical Consideration,” by K. Sriram & V. A. Lonchyna, 2009, *Journal of Parenteral and Enteral Nutrition, 33*, 548. doi:10.1177/0148607108328470

Summary of Research

There are four goals for this study: the levels of micronutrients in a sample of allied health and nursing students, (2) to compare the estimated levels of micronutrients to the recommended daily allowances for these micronutrients in students, (3) to compare the estimated micronutrient levels in students with high-stress and low-stress students, and (4) to compare the estimated micronutrient levels of students with high-income to low-income students in a sample of first-year allied health and nursing students. The study was conducted using a sample from first-year allied health and nursing students. The NutritionQuest 2005 food frequency questionnaire was used to assess the habitual diet of each individual by asking the frequency of various food groups and portion size consumed daily, weekly, or monthly. This method will make it possible to identify inadequate intake of any food group that contributes to micronutrient deficiency, which usually is initiated by an inadequate dietary intake of one or more food source. The Perceived Stress Scale (PSS) was used as the tool to measure students with high-stress-levels versus students with low-stress-levels, and compare them to each micronutrient RDA levels.

Social, economical, and environmental factors can all contribute to the different types of deficiencies. For example, different foods will contain different types of nutrients that are essential for the body to function properly and efficiently. However, economic factors such as income can allow for access to the different types of foods that are micronutrient-rich, and fortified for better health services. In other words, greater income with access to these foods, contribute to the decreased risk and prevalence of micronutrient deficiency. This study used each student's income levels to determine high-income levels versus low-income levels and compare them to each micronutrient RDA levels. The following chapter will outline the methods used to evaluate micronutrient levels in the study population selected for this study.

Chapter 3: Research Methodology

Introduction

This quantitative research study was designed to determine the estimated micronutrient levels in a sample of allied health and nursing students and compare these levels to the RDA for these micronutrients. The estimated micronutrient RDA levels were used to compare students with high-income to students with low-income, and to compare students with high-stress levels to students with low-stress levels in a sample of first-year allied health and nursing students. The initial investigation of previous research established that while the presence of certain micronutrient deficiency has long been present in critically ill (Sriram & Lonchyna, 2009) and elderly populations, recent researchers suggested that younger, seemingly healthier populations (Butler et al., 2006; Holst-Schumacher, Monge-Rojas, & Barrantes-Santamaria, 2007) may be at-risk of the long-term deleterious effects of micronutrient deficiencies (Holst-Schumacher et al., 2007).

This chapter is a description of the methodology and instruments that were used to determine the estimated levels of micronutrients and compared these levels to the recommended daily allowances in a sample of students from Keiser University. The chapter begins with a review of research paradigms traditionally used in epidemiological research. The justification of the research paradigm acts as a supportive mechanism for the selection of a quantitative design using survey methodology. A survey design was the most appropriate strategy of inquiry to explore the research questions for this study. After presenting details in support of the use of a survey design for this study, the focus of the chapter transitions to highlight the research questions and key components of the research plan, including the setting and sample selection process, instrumentation and material, and data collection and data analysis plans. The chapter ends with a discussion about ethical considerations and concluding thoughts.

Research Design and Rationale

This study used a cross-sectional survey design with face-to-face interviews, and a web-based self-administered questionnaire. The methods used for the questionnaire and interview are further described in the data collection section of this chapter. Given the nature of this study, the survey design was selected as the most appropriate design to explore the research hypotheses. Frankfort-Nachmias and Nachmias (2008) described the research design as a "blue-print" for an investigator to solve or explore a certain phenomenon or problem (p. 89). A nonexperimental cross-sectional survey design was used to conduct this study. Surveys are feasible when the goal is to quantitatively explore or identify trends. Cross-sectional design has been used in social research to "describe the pattern of relationship between variables" (Frankfort-Nachmias & Nachmias, p. 117). The intent of this study was to determine if there were any micronutrient deferences found in a sample of allied health and nursing students. This study was not designed to identify any causal relationship; as such, use of a cross-sectional survey design was most appropriate. According to Babbie (2010), a cross-sectional design is often used as an exploratory, or descriptive, method to find inferences about possible relationships or to gather preliminary data to support further research and experimentation.

A face-to-face survey design was used during the prescreening as a complementary mode to the web-based self-administered survey questionnaire implemented in this research study. Frankfort-Nachmias and Nachmias (2008) showed that face-to-face surveys have the advantage of personal interaction, clear instructions, question variety, flexibility and adaptability, use of probing techniques, ability to use physical stimuli, capability to observe respondents, and control over the survey environment (pp. 218-222). During Phase II of this research, a web-based self-administered survey questionnaire was implemented. A web-based survey involves the collection of data that are applied through a self-administered electronic set of questions on the Internet (Frankfort-Nachmias & Nachmias, 2008). Current studies indicate that carefully designed web-based questionnaires as a mode of data collection in epidemiologic research can adequately be used for college students, as well as men and women of reproductive age (van Gelder, Bretveld, & Roeleveld, 2010). Creswell (2009) explained that a survey design allows a researcher to generalize about a population's trend through the use of a sample (p. 145). The use of surveys as a research technique dates back to the biblical era (Babbie, 2010). The survey has been identified as the best method available for collecting original data to describe a population. Surveys are typically used when the unit of analysis is at the individual level.

Research Hypotheses

The main question to be answered in this research was the following: Are there differences between micronutrient deficiencies in allied health and nursing students at Keiser University on the Miami, Florida, campus when RDA levels are compared? The role of income and stress levels as potentially related to micronutrient uptake of study participants was also examined. The dependent variable was micronutrient levels. The independent variables were stress and income levels. The aim of the study was to answer the following research questions:

1. Are there differences between micronutrient intake levels in allied health and nursing students at Keiser University on the Miami, Florida campus when RDA levels are compared?

   $H0_1$: There is no significant difference between the levels of micronutrients estimated in a sample of first-year allied health and nursing students and the RDA for each micronutrient.

   Ha_1: There are differences between the levels of micronutrients estimated in a sample of first-year allied health and nursing students and the RDA for these micronutrients.

A one-sample *t* test was used to determine the mean micronutrient levels for the study participants relative to the estimated RDA values.

2. Do micronutrient levels in allied health and nursing students at Keiser University on the Miami, FL campus differ by their income status?

   $H0_2$: There is no significant difference between the levels of micronutrients estimated in a sample of low-income first-year allied health and nursing students and the levels of high-income students.

   Ha_2: There are differences between the levels of micronutrients estimated in a sample of low-income first-year allied health and nursing students and the levels of high-income students.

The two-sample *t* test was performed to compare the mean of the two different samples: allied health students and nursing students. The two-sample *t* test was also used to compare the mean distributions of micronutrients between high-income and low-income students. Multiple linear regression (MLR) was used to examine the association of stress and income with micronutrient levels. The multivariate model also included gender to adjust for potential confounding by this variable.

3. Do micronutrient levels in allied health and nursing students at Keiser University on the Miami, Florida campus differ according to stress level?

   $H0_3$: There is no significant difference between the levels of micronutrients estimated in a sample of low-stress first-year allied health and nursing students and the levels in high-stress students.

   Ha_3: There are differences between the levels of micronutrients estimated in a sample of low-stress first-year allied health and nursing students and the levels in high-income students.

A two-sample *t* test was used to compare the distributions of micronutrients between high- stress and low-stress and high-income and low-income levels in students. Multiple linear regression was also used to examine the association of stress and income with micronutrient levels. The multivariate model also included gender to adjust for potential confounding by this variable.

A more detailed breakdown of study variables is listed below:

Demographics :

1. Type of allied health student
2. Semester currently enrolled
3. Gender
4. Age
5. Marital status
6. Who do you live with?

7. How many persons live in your household?
8. Currently working / hours
9. Yearly total household income
10. Household income based (dependent/independent/joint)
11. Do fell like your dietary intake is based upon what you can afford?
12. Do you ever find that your dietary selections are based upon price?
13. How often are your dietary intake choices based upon what you can afford during the week?
14. Race/ethnicity
15. Hours per day spend studying
16. Hours spend each week in class
17. Hours of sleep each night

Stress:

In the last month,

1. How often have you been upset because of something that happened unexpectedly?
2. How often have you felt that you were unable to control the important things in your life?
3. How often have you felt nervous and stressed?
4. How often have you felt confident about your ability to handle your personal problems?
5. How often have you felt that things were going your way?

6. How often have you found that you could not cope with all the things that you had to do?
7. How often have you been able to control irritations in your life?
8. How often have you felt that you were on top of things?
9. How often have you been angered because of things that were outside of your control?
10. How often have you felt difficulties were piling up so high that you could not overcome them?

Micronutrients:

1. A
2. B
3. B12
4. C
5. D
6. E
7. K
8. Iron
9. Calcium
10. Zinc
11. Folate

Setting and Sample

This study was conducted at Keiser University (KU). KU is a private institutionally accredited university with degree programs ranging from associate's degree level to doctoral level programs. KU is based in Florida, with 14 campuses across the state. This study was conducted at the Miami campus in allied health and nursing students. The sample for this study was selected from a first-year enrollment class in the Allied Health and Nursing Department. Freshman students are challenged with stressors that include a change in living situation and difficult coursework, which may lead to unhealthy eating, weight gain, and lack of sleep (Hodge, Jackson, & Sullivan, 1993; Hoffman, Policastro, Quick, & Soo-Kyung, 2006).

In the fall term of 2011, the total enrollment of freshman students in this division consisted of 280 students. The freshman class for the academic year 2009-2010 was 30.8% male and 69.2% female (StateUniversity.com, 2012). In addition, just under half of the students in this enrollment class were White (43.3%), were Black (23.5%) and Hispanic/Latino (27.6%), and the remaining students were American Indian or Alaskan Native (1.3%), Asian, Native Hawaiian or other Pacific Islander (2.3%).

Sampling and Sampling Procedures

A random sample of the students was selected from a first-year class. Creswell (2009) explained that a random sample is a stronger design. In a random sample, each individual in the population has an equal chance of being selected, leading to an unbiased representative sample of the target population. A power analysis was used to determine the adequate random sample that gave considerable statistical and clinical significance between the sample group and the RDA. As the data collection processes and the use of the validated tool (NutritionQuest) were expensive, the minimal number of cases needed to demonstrate the statistical power for each group of micronutrients and the RDA was used in the study.

G*Power was used to determine the appropriate study sample size. G*Power is statistical software designed to be a stand-alone power analysis program for statistical testing (Faul, Erdfelder, Lang, & Buchner, 2007). G*Power software (version 3.1.3) was used to calculate tests of power for sample size estimation. G*Power has been considered a reliable software program when computing power analyses for statistical testing (Faul et al., 2007). A Cohen's *d* value of effect size was used to determine the sample size. Cohen's *d* values of an effect size of 0.2-0.3 are small effect, 0.5 is a medium effect, and 0.8-0.10 is a large effect (Cohen, 1988, 1992). According to Cohen (1988), "the terms small, medium and large are relative, not only to each other, but to the area of behavioral science or even more particularly to the specific content and research method being employed in any given investigation" (p. 25). A one-sample *t*-test analysis was completed to look at each group of micronutrients and the RDA. In addition, a two-sample *t* test and multiple linear regression were used to compare the levels of micronutrient RDA levels to the stress level (high vs. low) and income (high vs. low) of each sample student. The multivariate model also included gender to adjust for potential confounding by this variable. An a priori power analysis was computed to establish the required sample size, given α, power, and effect size. A small effect size of 0.25 was assumed, along with a power of 0.80 (1-β error probability) and alpha of error probability of 0.05. The resulting sample size was 95 total participants. The attendance records for the first-year allied health and nursing students indicated that dropout at Keiser University was approximately 6.67% (six students). An additional 30% (29 students) were recruited and accounted for refusal and attritions during the implementation of the research study.

The sample *t* tests were used for comparisons of micronutrient levels and the RDA levels. A priori, a *p*-value of < 0.05 was selected to indicate statistical significance. The results of the *t*-test analyses evaluated significance with *p*-values. There was no adjustment for multiple comparisons, but chance significant differences were closely monitored, and all findings were evaluated to assess clinical significance (e.g., magnitude of differences), if any. Multiple linear regression (MLR) models were used to examine the independent association of stress and income with micronutrient levels. The multivariable model also included gender to adjust for potential confounding by this variable. The MLR is based on least squares; the model is fit such that the sum-of-squares of differences of observed and predicted values is minimized. Parameter estimates are provided for the MLR analyses, along with their corresponding *p*-values. MLR is used as a method to model the linear relationship between a micronutrient (dependent variable) and stress and income levels (independent variables).

This study also assessed the assumptions of the regression model, namely normality, through appropriate regression diagnostics by examining the coefficient of multiple determination, R^2, and residuals. The multiple regression model fit the linear model with two or more predictors. Stepwise regression model building was used with the MLR because of the small number of cases and the potential relationship between the independent variables. The results of the *t tests* were evaluated to show the significance of the *p*-values, while the MLR was used to present the parameter estimates.

Procedures for Recruitment, Participation, and Data Collection

A list of first-year students was obtained from Keiser University's admissions department. Approximately 124 students were recruited to participate in this study.

Sample participants were notified via email that they had been selected to be part of a research study. The following steps describe how eligible participants were enrolled into the study.

1. Keiser University approved the study to be conducted with a sample of allied health and nursing students once a copy of the Walden's University IRB approval was submitted to Keiser University IRB (see attached KU letter).
2. A copy of the Walden IRB approval was submitted to Keiser University IRB for final approval, and to access data, and student participation.
3. The admissions department provided identification numbers for first-year allied health and nursing students. The purpose of the admissions department to provide identification numbers for first-year allied health and nursing students' was to identify all students that were enrolled in the program and avoid sending a massive invitations to other specialties. This avoided other participants that were not first-year allied health or nursing students of getting information of the study.
4. A letter of announcement and invitation on my behalf was sent by the administration office to all first-year allied health and nursing students. The letter contained a brief explanation of the study, and a copy of the consent form. Inclusions and exclusions was explained for Phase I, and Phase II of the study. Students that decided to participate in the study, sent their consent form with their student university identification number to the researcher's Walden email (grisseel.cruz-espaillat@waldenu.edu). Once the researcher

received all signed consents, a list of student identification numbers was entered into an SPSS file.

5. Selected sample participants were notified via email (see attached Participation Notification letter) that they had been randomly selected to participate and complete the study survey. The notice included scheduled dates and times for participants to complete the survey.
6. On the day of their scheduled appointment students were asked to show their student university ID card. The student ID number on the card matched the student number that was submitted by the participant when they forward the signed consent form to the researcher. Once verified, each participant was asked to be seated in individual cubicles in the university's library where they were able to complete the paper forms and the electronic surveys privately. Each cubicle had a computer that students logged in to have access to the online surveys in Phase I and Phase II of the study.
7. In Phase I participants completed the demographic form, and perceived stress survey that was given in a paper format.
8. Once they finished with the paper forms, the researcher collected the forms and place them in a folder that was prepared. A copy of the signed consent form that was sent by the participant was placed in the folder for verifications of consent. The entire folder was than placed in a secured box and was only handled by the researcher. The online data was available to the researcher by using a secured password.

9. In Phase I, the participants completed the fruit & vegetable prescreen survey. Students that scored more than 17 in the fruit & vegetable survey did not meet the inclusions for Phase II of the study.
10. Students that met the qualifications for Phase II data collection, completed the food frequency questionnaire survey (NutritionQuest data-on-demand online system- Block 2005 FFQ ©). Researcher instructed the participants on the use of the system, and waited while the first two sample questions were answered to ensure that the participant was able to navigate the CASI system. Once proper navigation was confirmed, the researcher allowed the participants to complete the nutritional analysis survey independently. Once students were done with the survey, they were asked to log out of the system and thanked for their participation.
11. Since all of the participants were not scheduled on the same date and time, Step 6, 7, 8, 9, and 10 of the process was repeated until all participants had completed their forms and surveys.

The email invitation contained a brief description of the study, information explaining the volunteer nature of the study, and the rights of the research participants. Study participants received a consent form to review before agreeing to participate in the study. A second email was sent to confirmed participants with the scheduled date, time and survey location (university's library).

Data Collection

As indicated in the sample selection process, the initial invitation to participate in the study included a brief description of the purpose of the research. In addition to this notification, students received a letter from KU indicating the support of the university for this study. The data collection process was conducted in the library of KU at the Miami, Florida campus. The surveying process continued over a 5-day work week during the semester.

Students were asked to validate their identification by showing their student ID with the student number used for the participant selection process. After verifying the identification of the students, informed consents were obtained and filed. Students were provided with a hard copy of the consent form for their records and directed to the prescreening area, where the researcher conducted a brief prescreening survey to collect demographic information and determine eligibility status for Phase I data collection. All prescreening survey scores were calculated and continued to phase II of the study. The Block Fruit-Vegetable-Fiber Screener scores and descriptions are designated as follows:

- 0-10: You are not eating enough fruits and vegetables! You are probably eating fewer than 3 servings a day, but experts recommend 5 or more. You may be low in important vitamins, and fiber. Pick a few fruits or vegetables you like, and eat more of them. Green salad counts, too, and fruit juice or vegetable juice.
- 11-12: Your diet is like most Americans — low in fruits and vegetables! You're eating fewer than 4 servings, but experts recommend 5 or more. Pick some you like, and eat them more often. Green salad counts, and fruit juice or vegetable juice.
- 13-15: You are doing better than most people, but you are still not eating 5 servings of fruits and vegetables every day. Try adding fruit or vegetable

juice, or salad – or just any fruit or vegetable you like.

- 16+: Congratulations! You're doing very well in fruits/vegetables, probably around 5 servings a day! Go for it!

Study Eligibility

Students eligible for the study were (a) between 18 years or older: (b) currently first-year allied health and nursing students, (c) were not a current or future student of the researcher, (d) provided a signed consent form to pariticipate in the study, (e) completed the demographic form, (f) completed the fruit & vegetable prescreen, and (g) scored less than 17 on the Block Fruit-Vegetable-Fiber Screener. Participants who completed the prescreening tool and did not qualify for phase II of the study were informed that they did not qualify, but continued to the next step of the study. Students were scheduled to participate during time frames that did not interfere class time.

Inclusion criteria to participate in the research were males or females that were currently first-year allied health and nursing students who provided informed consent to participate in the study, and who scored less than 17 in the Block Fruit-Vegetable-Fiber Screener. The exclusion criteria was current and included the future students of the research who scored more than 17 in the Block Fruit-Vegetable-Fiber Screener. Subjects that met the inclusion criteria proceeded to Phase II of the survey. Students that met the qualifications for Phase I data collection were informed of their status, and then escorted to a CASI station in the library. The CASI stations was programmed with the nutritional analysis survey. The researcher instructed the participant on the use of the system, and waited while the first two sample questions were answered to ensure that the participant could navigate the CASI system. Once proper naviagation was confirmed, the researcher returned to the prescreening area and allowed the participant to complete the nutritional analysis survey independently. The researcher repeated this process until the adequate number of participants were recruited during the 5-day work week.

Instrumentation and Materials

NutritionQuest is an official source of the Block Food Frequency Questionnaire, as well as other dietary and physical activity questionnaire (Nutrition Quest, 2009). NutritionQuest functions on a Data-on-Demand server that provides an online data collection, nutrient and physical activity analysis, and data management (Nutrition Quest, 2009). The adapted database use for collecting selection of foods is acquired from the National Health and Nutrition Examination Survey (NHANES). NutritionQuest data-base, analysis and management has been used by various organizations which include the Agricultural Research Service (USDA/ARS), American Cancer Society, CDC, Duke University Medical Center, Emory University School of Medicine, Florida International University, Harvard Medical School, Harvard School of Public Health, Harvard University, John Hopkins School of Public Health, Johns Hopkins School of Medicine, University of Miami, University of South Florida, and Yale University School of Medicine (NutritionQuest, 2009).

Block Rapid Food Screeners Questionnaire

The Block Rapid Food Screeners Questionnaire (dietary fat and fruit-vegetable-fiber) was validated by Block, Gillespie, Rosenbaum, and Jenson (2000). Based on the recommendations from the U.S. Prevention Service Task Force to reduce the prevalence of cardiovascular diseases, cancer, stroke, obesity, and diabetes, Americans are recommended to lower the intake of dietary fat and cholesterol, and to increase the intake of fruit, vegetables and fibers (Block, Gillespie, Rosenbaum, & Jenson, 2000). Block et al. (2000) used a one-page screener based on the National Nutrition Data, which was abstracted from the full-length questionnaire. In the study, two hundred adults self-administrated food screener and demonstrated a correlation of 0.6-0.7 ($p < 0.0001$) for total fat, saturated fat, cholesterol, fruit, and vegetable intake. The screener was able to identify individuals with high percentage calories from fat, total/saturated fat, or cholesterol, as well as identify those individuals that were not taking the necessary dietary requirements of vitamin C, fiber or potassium (Block et al., 2000).

Full-length Block Food Frequency Questionnaire

The second assessment was a full-length questionnaire that concentrated on approximately 110 wide varieties of nutrients and food groups. This format was self-administered and took approximately 50 minutes to be completed. The food list that was used for this analysis was from the NHANES 1999-2002 dietary recall data, which was developed using version 1.0 of the USDA Food and Nutrient Database for Dietary Studies (FNDDS). The Block Questionnaire 2005 Food Frequency Questionnaires for Adults provided questions that assessed the intake of fats, and carbohydrates. Individual food portions were also a part of the assessment. The questionnaire did provide images that helped participants in the accuracy of quantifying food intake (NutritionQuest, 2009). The full-length dietary questionnaire was developed by Dr. Gladys Block at the National Cancer Institute (NCI) and has continually been improved and updated. These questionnaires have been used in more than 700 research and public health organizations within the United States. The Full-length Block Food Frequency Questionnaires have been validated by various publications on dietary data (NutritionQuest, 2009). Mares-

Perlman et al. (1993) and Block, Woods, Potosky, and Clifford (1990) described the validation of earlier versions of the questionnaire, while Block et al. (1986) and Block, Coyle, Hartman, and Scoppa (1994) validated the methodology used to determine the group foods, which was include in later versions of the full-length food frequency questionnaires.

The Perceived Stress Scale

The Perceived Stress Scale (PSS) is the most widely used psychological instrument measuring the extent to which individuals perceive their life as stressful (Cohen & Janicki-Deverts, 2012; Cohen, Kamarck, & Mermelstein, 1983). The participants used a 5-point Likert scale response format ranging from 0 being “never” to 4 being “very often” (Cohen & Janicki-Deverts, 2012; Cohen et al., 1983). Various researchers have validated the use of this psychological instrument to demonstrate possible associations between stress, depressive symptoms, eating behaviors, and weight gain (Mikolajczyk et al., 2009; Wichianson et al., 2009).

This study used the 10-item PSS to measure the stress levels of each student by using a 5-point Likert scale (0 = “never” to 4 = “ very often”). The PSS-10 scores were obtained by reversing the scores for the positively stated items 4,5,7, 8 (0 =4, 1=3, 2=2, 3=1, and 4=0) and then summing across all 10 items. Higher PSS scores indicates the likelihood for stress, and vulnerability to compromised health (Cohen & Janicki-Deverts, 2012; Cohen et al., 1983; Mikolajczyk et al., 2009; Wichianson et al., 2009). Sample students with total scores less than 15 total score levels, were considered to be within the low-stress-levels, while students with a 16 and higher total score level were considered to range in the high-stress levels. Table 4 provides the different levels of perceived stress and health concerns. These scores were use to measure micronutrients levels compared to low-stress versus high-stress levels.

Table 4

Interpretation of PSS Scores

Total score	Perceived stress level	Health concern level
0-7	Much lower than average	Very low
8-11	Slightly lower than average	Low
12-15	Average	Average
16-20	Slightly higher than average	High
21 and over	Much higher than average	Very high

Note. From "A Global Measure of Perceived Stress," by S. Cohen, T. Kamarck, & R. Mermelstein, 1983, *Journal of Health and Social Behavior*, *24*, 385-396. Retrieved from http://www.psy.cmu.edu/%7Escohen/globalmeas83.pdf

Reliability Analysis

The internal consistency of a test or scale can be measured by using Cronbach's alpha (Tavakol & Dennick 2011; Streiner, 2003). According to Streiner (2003), internal consistency is needed to measure various aspects of personality test or scale. The numerical values of Cronbach's alpha range from 0.70 to 0.95 (Tavakol & Dennick, 2011; Streiner, 2003). A low score of a Cronbach's alpha suggests either a low number of questions or poor correlation between items, while too high levels may suggest redundance of some items. A maximum recommended alpha value is 0.90 (Tavakol & Dennick, 2011; Strener, 2003).

Income Interpretation

The 2011 U.S. Census Bureau median household income in the United States decreased 1.3 percent from $51,144 to $50,502 (DeNavas-Walt, Proctor, & Smith, 2012; U.S. Census Bureau, 2013), while Florida's median household income estimate is $53,509 (U.S. Census Bureau, 2013). According to the U.S. Census Bureau, median is "the point that divides the house-hold income distribution into halves, one half with income above the median and the other with income below the median. The median is based on the income distribution of all households, including those with no income" (DeNavas-Walt et al., 2012; U.S. Census Bureau, 2013). Students were classified into high-income or low-income-levels based upon the distribution of responses from first-year allied health and nursing sample students (see Table 5).

Table 5

Florida Median Household Income

Florida	Estimate	Margin of error (+/-)
Total median	$53,509	474
2-person families	$49,321	529
3-person families	$53,713	925
4-person families	$64,084	1,312
5-person families	$60,656	1,783
6-person families	$56,679	2,222
7-or-more-person families	$59,498	3,972

Note. From U.S. Census Bureau, 2013.

Data Analysis

At the end of the data collection process, data from the prescreened interviews were used to create a dataset in Statistical Package for the Social Sciences (SPSS) for Mac version 21.0 (See Appendix A). Additionally, data from the self-administered nutritional analysis survey on the CASI system was entered into the database, which was previously created in SPSS and merged with the interview data (See Appendix B, C, and D). As a method to clean the data, frequency analyses were completed on the data set to identify any missing variables. Cases that were missing variables were included in this study.

As suggested by Creswell (2009), a six-step process for analyzing quantitative data in social research was employed. Data on the study participants was presented using descriptive statistics, including the number and percentages of study participants that returned the consent forms, the number of completed prescreening surveys, the perceived stress scale, and the number completing the self-administered nutritional questionnaire. Demographic information as race, gender, age, academic focus, employment types, income, and other information about the study participants was provided.

This research posed the question: Are there differences between micronutrient intake levels in allied health and nursing students at Keiser University on the Miami, Florida, campus when RDA levels are compared? The role of income and stress levels, and micronutrient uptake of study participants were also examined. The dependent variable was micronutrient levels. The independent variables were stress and income levels. The aim of the study was to answer the following research questions:

1. Are there differences between micronutrient intake levels in allied health and nursing students at Keiser University on the Miami, Florida, campus when RDA levels are compared?

$H0_1$: There is no significant difference in the levels of micronutrients estimated in a sample of first-year allied health and nursing students and the RDA for each micronutrient.

Ha_1: There are differences in the levels of micronutrients estimated in a sample of first-year allied health and nursing students and the RDA for these micronutrients.

2. Are micronutrient levels in allied health and nursing students at Keiser University on the Miami, FL campus differ by their income status?

   $H0_2$: There is no significant difference in the levels of micronutrients estimated in a sample of low-income first-year allied health and nursing students compared to high-income students.

   Ha_2: There are differences in the levels of micronutrients estimated in a sample of low-income first-year allied health and nursing students compared to high-income students.

3. Do micronutrient levels in allied health and nursing students at Keiser University on the Miami, Florida, campus differ according to stress level status?

   $H0_3$: There is no significant difference in the levels of micronutrients estimated in a sample of low-stress first-year allied health and nursing students compared to high-stress students.

   Ha_3: There are differences in the levels of micronutrients estimated in a sample of low-stress first-year allied health and nursing students compared to high-income students.

Descriptive analysis of the data was provided. This included mean, standard deviations, and range of scores of the dependent and independent variables. Another step in the data analysis process included a check for reliability and validity of the data. The instruments used for this study were previously established for reliability and validity checks. The hypothesis testing was conducted by using a one-sample *t* test to compare the level of micronutrients, and the student sample to the RDA level.

Threats to Validity

Potential threats to internal validity in this study included selection bias, reliability of measures and procedures, and order effects. Selection bias can occur if the students who volunteer to participate and are highly deficient, do not get the chance to participate in the study. Removal of these students could have an effect on the statistical averages for the study. The threat of reliability of measures and procedures occur when students do not receive the same instructions for completing the questionnaires. This error can occur if the researcher fails to relate a vital piece of information about completing the questionnaires to some of the study participants. In addition, order effects could have occurred in this study if the student became bored and disinterested during the process of completing the questionnaire, and either did not complete it, which results in drop-out, or did not answer the questions truthfully, which results in an order effect.

Other possible threats to internal validity are instrumentation or human error. There was a potential for problems with the computers in the Keiser University library where the questionnaires were completed. Human error was possible when data results where compilied.

One main threat to external validity is population validity. It is assumed that the results from this study can be generalized to allied health and nursing students. Given the outcome where the population in this study are a mixture of ages, it could be questioned whether a general statement can be made based on freshmen students at Keiser University. College students are used frequently in study designs that generalize treatments or effects for the general population. This study made every effort to have a diverse group of student participants so that the results can be generalizable for the intended population. Gender bias could also occur as studies have shown that female college students are more likely to be more health conscious than their male counterparts.

Ethical Consideration

The primary mode of data collection for this study was implemented through surveys. Kelly, Clark, Brown, and Sitzia (2003) suggested that when using the survey method, the researcher should focus on informed consent and the confidentiality of the participants. To ensure informed consent for this study, strict guidelines were followed. When invitations went out to the potential study participants, an electronic copy of the consent form was emailed with the invitation. The consent form highlighted the nature of the study, explained how the results will be shared, included a statement explaining the voluntary nature of the study, and provided information on how to contact the principal investigator and/or Walden University's Research Division for additional information about the study. Prior to completing the prescreening process, researcher reiterated the consent clause and asked for a verbal confirmation of the participants consent in addition to written informed consent. Participants were notified that while they had provided consent, they still had the option of leaving questions that made them uncomfortable blank or of ending the survey at any time.

The surveys were conducted in the KU library on campus, and procedures to ensure participant confidentiality were employed. The library does not have private meeting rooms; however, the librarians identified the most appropriate space to set up the face-to-face interviews for the research assistants and the students. The computer stations are not located in individual rooms; however, they are in individual cubicles providing a semi-confidential area for the students to complete the web-based self-administered nutritional questionnaire. The researcher worked to reinforce the library's quiet policy and to ensure that students could complete the two processes undisturbed.

A major consideration for this study involved the fact that the primary researcher is also a full-time faculty member of KU in the science department. The sample for this study was selected from first-year students. It is possible that some of these students ultimately will be enrolled in the course taught by the primary investigator. Given the teacher-student relationship, steps were taken to ensure that any real or perceived coercion issues are addressed during each step of the research process. To minimize the risk of coercion or perceived coercion, the following steps were taken:

1. Initial invitation was sent by administration offices on behalf of the researcher.
2. Students that participated in the study were not currently enrolled or have future course enrollment with the primary investigator.
3. Students were notified in writing and verbally that they could opt out of the study at any time without fear of penalty, judgment, or retribution.

All first-year allied health and nursing students received from the administration office a letter of invitation in behalf of the researcher. Students that were interested in participating in the research study sent a signed consent to the researcher. These students received an email notification that they had been selected to participate in the study. The researcher did not conduct any recruitment activities or announcements in the classroom to reduce the risk of possible perceived coercion of the students. During the study, the researcher provided instructions to students on the CASI system.

Another issue of concern for this study was the identification of subjects at extreme risk of nutritional deficiency. Study participants who qualified for the first phase of the study by indicating possible risk in the prescreening tool received an information packet about improving their diet and a referral to the student center for nutritional counseling. Nutritional counseling was not the goal of this study; no student participant received nutritional counseling from the researcher.

Protection of Participants' Rights

A protocol for Human Subjects in Research was completed and submitted to Walden University's Institutional Review Board for approval. The protocol was approved before any data analysis was completed for this study. All of the data used in this research was kept in a password-protected file on a password-protected computer. Students were only identified by student ID number with no link to their actual identities. No identifying information was linked to the students. After five years, the data will be destroyed by deleting it from the computer.

Summary

A quantitative research design was used to determine if there was a relationship between the dependent and independent variables. A survey design was used to collect the data necessary for this study. Random sampling was utilized in the selection process. Descriptive statistics using mean, standard deviation, and frequency were analyzed and reported, in addition to the *t*-test analyses that were used to analyze data in SPSS.

Chapter 4 provides a complete report of the results found in this chapter. The report to follow in Chapter 4 also includes descriptive statistics and statistical assumptions where appropriate. Accompanying tables and figures illustrating data results are also included in Chapter 4.

Chapter 4: Results

Introduction

The purpose of this quantitative cross-sectional study was to determine the estimated micronutrient levels among a sample of allied health and nursing students and compare these levels to the recommended daily allowances for these micronutrients at Keiser University in Miami, Florida. In addition, I sought to compare mean levels of micronutrients among students with high and low-income-levels, as well as students with high- and low-stress-levels. The data analysis was performed by using a set of surveys (demographic, stress levels, and food frequency questionnaires) from 125 (67.6%) first-year allied health and nursing students. The aim of the study was to answer the following research questions:

1. Are there differences between micronutrient intake levels in allied health and nursing students at Keiser University on the Miami, Florida campus when RDA levels are compared?

   $H0_1$: There is no significant difference between the levels of micronutrients estimated in a sample of first-year allied health and nursing students and the RDA for each micronutrient.

   Ha_1: There are differences between the levels of micronutrients estimated in a sample of first-year allied health and nursing students and the RDA for these micronutrients.

2. Do micronutrient levels in allied health and nursing students at Keiser University on the Miami, FL campus differ by their income status?

H0₂: There is no significant difference between the levels of micronutrients estimated in a sample of low-income first-year allied health and nursing students and the levels of high-income students.

Ha₂: There are differences between the levels of micronutrients estimated in a sample of low-income first-year allied health and nursing students and the levels of high-income students.

3. Do micronutrient levels in allied health and nursing students at Keiser University on the Miami, Florida campus differ according to stress level?

   H0₃: There is no significant difference between the levels of micronutrients estimated in a sample of low-stress first-year allied health and nursing students and the levels of high-stress students.

   Ha₃: There are differences between the levels of micronutrients estimated in a sample of low-stress first-year allied health and nursing students and the levels of high-income students.

Statistical analyses presented in this chapter include the one sample *t*-test, multiple linear regression, and nonparametric tests including the Mann-Whitney U test. Study results are displayed using boxplots, tables, and figures. More specifically, the first research question and the related hypothesis were evaluated with a two-tailed one-sample *t* test. The second and third research questions, along with their respective hypotheses, were evaluated with two-tailed independent sample *t* tests, Mann-Whitney U tests, and multiple linear regression. This chapter includes descriptions of the data collection process, the results of the data analysis, and a summary of the findings.

Data Collection

Subject Recruitment

After receiving approval from Walden University's Institutional Review Board (Approval number 09-18-13-0141019) and Keiser University's Institutional Review Board (Approval number IRB000SE13GC3) to conduct this study, I gathered information from the Admissions Department regarding admission numbers and the email addresses of first year allied health and nursing students enrolled at Keiser University. Keiser University's Administration Department sent a letter announcing the study and an invitation for study participation to students' university email addresses; approximately 185 eligible students were contacted on behalf of the principal investigator. The first invitation letter was sent on October 16, 2013. After the first round of emails was sent to students, only two potential participants replied with an interest of study participation and completed the necessary consent forms. A second round of emails was sent to students on October 21, 2013, including the study announcement and an invitation letter to students' university email addresses. A total of 183 eligible students were contacted in the second round of email contact. None of the potential participants replied at the end of second round of emails. The Administration Department sent a third email with study announcement and invitation letter to eligible students' personal email addresses on October 24, 2013. On the third attempt, the administrator sent out emails to the students' personal email addresses because they were not responding to correspondence sent to their university email accounts. After the completion of the third round of emails to the students' personal email addresses, an additional 123 students showed interest in participating in the study and completed the necessary consent form. The total response rate for the study was 67.6% (125/185; see Table 6).

Table 6

Study Participant Recruitment

	Method	Response rate
First contact	Students' university email	2/185 (1.1%)
Second contact	Students' university email	0/183 (0.0%)
Third contact	Students' personal email	123/183 (67.2%)
Total responses		125/185 (67.6%)

Prescreening Data/Phase I

Of the 125 potential participants, 115 (92%) participated in Phase I of the study and completed the demographic questionnaire, perceived stress survey, and online fruit and vegetable prescreen survey. All 115 participants completed food frequency questionnaires (NutritionQuest data-on-demand online system—Block 2005 Food Frequency Questionnaire (FFQ) at a later date. All data questionnaires were collected from each participant and were stored under their unique student ID. The 115 students responded to all fruit and vegetable prescreening survey questions. Initially, demographic data, perceived stress data, and FFQ data were stored in separate Microsoft Excel spreadsheets. Only data collected from those eligible participants were extracted from these three different datasets and merged together by using student ID as the common variable to create a single database.

Phase II Screening

Initially, NutritionQuest agreed that if there were study participants who would not show up, they would reimburse, but NutritionQuest did not follow through on this initial agreement. Therefore, all students were allowed to proceed to Phase II of the study and complete the full version of the FFQ. Students who did not qualify on the FFQ (scored more than 17 on the Fruit and Vegetable screening) were eliminated, and their data were not further used for the study analysis. There were 22 students who did not qualify, and 10 did not show up. After Phase II testing, a total of 92 participants were eligible to continue with the study. According to the G*Power calculation, a total of 95 students were needed for the study. The study was short three participants.

Phase II consisted of the full-length Block 2005 FFQ survey. An online account was set up for the Block 2005 FFQ. The FFQ consists of a questionnaire designed to recollect each participant's daily dietary food intake and RDA. Phase II of the study took approximately 45-50 minutes and was scheduled during lunchtime. If study participants were not able to keep their scheduled lunchtime appointment, they could either reschedule or show up before class time (7-8:00 a.m.) or after class (1-2:30 p.m.). Once study participants proceeded to Phase II, each participant was registered for the NutritionQuest software and asked to log into the software by using his or her student ID number to begin the survey. When each participant completed the FFQ, each student was logged out of the software system and returned all questionnaire documents. All participant documents were locked in a portable file cabinet with a key that was only accessible to me. To verify FFQ submissions by participants, I confirmed the submission by logging into the website. After submissions are verified, participants were dismissed.

The data collection was spread out over a 3-week period due to lack of participants, midterm exams, and scheduling.

Once the data were collected, the folders were organized according to the allied health specialty and imported into Microsoft Excel. All of the data collected—demographics, Perceived Stress Survey, fruit and vegetable survey, and Food Frequency Questionnaire survey—were separately imported into Microsoft Excel. The Excel files were imported into SPSS file for data analysis.

Results

Demographic Data

Miami-Dade County is a multicultural city with a racial distribution of Hispanic or Latino (n = 1,622,824, 64.6%), Caucasians (n = 395,156, 15.7%), Black or African American (n = 433,889, 17.3%), Asian (n = 37,917, 1.5%), American Indian and Alaska Native (n = 2,124, 0.1%), and other races (U.S. Census Bureau, 2014). According to the 2008-2012 American Community Survey demographic and housing estimates, Miami-Dade County consists of a total population of 2,512,219 (male n = 1,217,277, 48.5% and female n = 1,294,942, 51.5%). The 2008-2012 American Community Survey also listed the median age for the local distribution in Miami-Dade as 38.2 years of age (18 years and over: male 47.7% and female 52.3%).

Data collection took place in Keiser University at the Miami campus from October 28, 2013 through November 14, 2013 (3 weeks). All participants of this study were students of Keiser University, which could introduce systematic bias because of estabilished institutional behavior patterns. The study participants were selected from the freshman class to minimize possible systematic bias. The overall goal was to identify a representative sample of participants for the study. All participants in Phase I were included in Phase II, so there was no difference in participants between phases. The final sample set consisted of 61 women (66.3%) and 31 men (33.7%). The participant group consisted of students primarily aged 30 years or younger (n = 61, 65%). The racial distribution included Hispanics/Latinos (n = 83, 90%), Caucasians (n = 2, 2%), and African Americans (n = 2, 2%). The majors of the students participating in the study included occupational medicine (n = 32, 35%), nursing (n = 25, 27%), radiology technician (n = 14, 15%), sports medicine (n = 13, 14%), and nuclear medicine technician (n = 8, 9%). The relationship statuses of the participants were never married (n = 54, 59%), married (n = 27, 29%), and divorced (n = 11, 12%). The participants were also surveyed on their current living status. There were participants who lived with their parents (n = 36, 40%), lived with a spouse or significant other (n = 18, 19.6%), lived with children only (n = 7, 7.6%), lived with a roommate (n = 3, 3.3%), and lived alone (n = 6, 6.5%). Without a controlling effect of participant living status on income level, a cross-tabulation between income level and participant's living status revealed that a higher porportion of participants living with parents had a higher income level compared to those participants living alone, which does not necessarily equate to participants living with parents having a higher income level then participants living alone. With this in consideration, more than 35% n = 33) of the participants had a total household income of less than $30,000 per year, almost 45 % (n = 41) of participants had a total annual household income between $30,000 and $60,000, and the remaining 19% of the participants (n = 18) had a total annual household income of greater than $60,000 (see Table 7). Florida's overall median household income for 2008-2012 was estimated to be

$47,309; Miami-Dade County's overall household income was estimated to be $43,464; and the U.S. overall median household income is estimated to be $53,046 (U.S. Census Bureau, 2014). The U.S. overall median household income ($53,046) falls within the $45,000-$60,000 median category used in the research study (see Table 7).

Table 7

Selected Demographic Characteristics of Study Participants

Characteristic (Categorical)	Category	*N* (%)
Gender	Male	31 (33.7)
	Female	61 (66.3)
Age group	18-21	7 (7.6)
	22-25	32 (34.8)
	26-30	22 (23.9)
	31-34	11 (12.0)
	35-39	12 (13.0)
	40-43	3 (3.3)
	44-47	3 (3.3)
	48+	2 (2.2)
Race/ethnicity	Caucasian	2 (2.2)
	African American	2 (2.2)
	Asian Pacific Islander	1 (1.1)
	Haitian	1 (1.1)
	Hispanic/Latino	83 (90.2)
	Other	3 (3.3)
Allied health major	Nursing	25 (27.2)
	Nuclear medicine tech	8 (8.7)
	Sports medicine	13 (14.1)
	Occupational medicine	32 (34.8)
	Radiology tech	14 (15.2)
Marital status	Never married	54 (58.7)
	Married	27 (29.3)
	Divorced	11 (11.96)
Domestic status	Live alone	6 (6.5)
	Live with roommate	3 (3.3)
	Live with spouse or significant other	18 (19.6)
	Live with spouse/significant other/children	22 (23.9)
	Live with parents	36 (39.1)
	Live with children only	7 (7.6)
Annual income	$15,000 or less	18 (19.6)
	$15,001 - $30,000	15 (16.3)
	$30,001-$45,000	22 (23.9)
	$45,001-$60,000	19 (20.7)
	$60,001-$75,000	5 (5.4)
	$75,001- $90,000	6 (6.5)
	$90,000 +	7 (7.6)

Characteristic (Continuous)	Mean (*SD*)	Median
Age	28.8 (7.3)	26

Descriptive Analyses

Mean, median, and standard deviation were used to describe the distribution of consumption of various micronutrients by the participants in the study sample (see Table 8). Other descriptive statistics used in the study included the minimum and maximum.

Table 8

Distribution of Intake of Micronutrients Among Study Population

Micronutrient	Mean±*SD*	Median	Minimum	Maximum
Vitamin A	836.0±529.2	734.9	190.7	3393.9
Thiamin	1.7 ±1.2	1.5	0.4	8.8
Riboflavin	2.2 ±1.3	1.9	0.7	9.3
Niacin	24.7 ±19.8	20.0	5.4	161.9
Vitamin B6	2.2 ±1.5	1.9	0.6	11.5
Vitamin B12	6.1 ±4.3	4.8	0.7	28.1
Vitamin C	107.4 ±77.0	91.8	15.7	444.7
Vitamin D	172.6 ±131.5	135.0	19.3	810.3
Vitamin E	9.3±5.8	8.2	2.4	39.2
Vitamin K	192.8 (145.6)	147.7	28.1	706.9
Iron	15.9 (10.6)	13.5	3.8	74.8
Calcium	923.7 (519.2)	832.2	174.3	2937.7
Zinc	14.0 (10.9)	11.8	2.8	71.9
Folate	594.0 (373.4)	509.3	161.0	2492.2

Micronutrient comparison. The mean level of each micronutrient under investigation was compared with the RDA value for that micronutrient (see Table 9). A prior, a p-value of < 0.05 was selected to indicate statistical significance level for null hypothesis of one-sample t-tests. The mean vitamin A intake among the study population was 836 µg per day, and it was significantly different from the RDA value of 700 µg/day. The true population mean of vitamin A intake was higher than the recommended intake value. Mean intake results for study participants included thiamine (1.7 mg/day), riboflavin (2.2 mg/day), and niacin (24.7 mg/day). These mean levels were significantly different from the RDA values of thiamine (1.1 mg/day), riboflavin (1.1 mg/day), and niacin (14 mg/day), with p-values < 0.05. The results for these three micronutrients suggested that their mean intake among the study population was higher than the recommended value. Likewise, mean levels of vitamin B6 (2.2 mg/day) and vitamin B12 (6.1 µg/day) were significantly different from the RDA values of vitamin B6 (1.3 mg/day) and vitamin B12 (2.4 µg/day). The results show that the mean intake of vitamin B6 and vitamin B12 was higher than the recommended values of these micronutrients.

The mean intake of vitamin C (107.4 mg/day) and vitamin D (172.6 µg/day) were significantly different from the RDA values for vitamin C (75 mg/day) and for vitamin D (15 µg/day), (p-value < 0.05). The mean intake of vitamin E (9.3 mg/day) was significantly lower than the RDA value of vitamin E (15 mg/day), (p-value < 0.05), and the mean intake of vitamin K (192.8 µg/day) was statisitcally significantly higher among study participants compated to the RDA for vitamin K (90 µg/day), (p-value < 0.05). Similarly, the mean intake of iron (15.9 mg/day), calcium (923.7 mg/day), zinc (14 mg/day), and folate (594 µg/day) among study populations was significantly different from the mean RDA values of iron (8.1 mg), calcium (800 mg), zinc (6.8 mg), and folate (400 µg). The mean intake levels of iron, calcium, zinc, and folate were higher among the study population compared to the recommended values (p-value < 0.05).

Table 9

Comparison of Mean Intake of Micronutrients With Recommended Dietary Allowance (RDA) Values

	Mean intake	RDA value	t-statistic	Sig^	95% CI
Vitamin A	836	700	2.46	0.016	726.4, 945.6
Thiamine	1.7	1.1	5.04	< 0.0001	1.5, 1.9
Riboflavin*	2.2	1.1	7.95	< 0.0001	1.9, 2.4
Niacin*	24.7	14	5.19	< 0.0001	20.6, 28.8
Vitamin B6*	2.2	1.3	5.55	< 0.0001	1.9, 2.5
Vitamin B12#	6.1	2.4	8.36	< 0.0001	5.2, 7.0
Vitamin C*	107.4	75	4.03	< 0.0001	91.4, 123.3
Vitamin D#	172.6	15	11.49	< 0.0001	145.3, 199.8
Vitamin E*£	9.3	15	-9.45	< 0.0001	8.1, 10.5
Vitamin K#	192.8	90	6.77	< 0.0001	162.7, 223.0
Iron*	15.9	8.1	7.04	0.000	13.7, 18.0
Calcium*	923.7	800	2.29	0.025	816.2, 1031.2
Zinc*	14	6.8	6.35	0.000	11.8, 16.3
Folate#€	594	400	4.98	0.000	516.7, 671.3

Note. # micronutrients measured in µg/day, * micronutrient measured in mg/day, § as retinol activity equivalents (RAEs), £ as α-tocopherol, € as dietary folate equivalents (DFE), ^ all p-values are significant at 5% level.

Income levels comparison. Figure 1 shows the result of the intake of micronutrients among participants with high-income level compared to participants with low intake level. Table 10 shows the results of the comparison of average levels of micronutrient intake among high-income and low-income groups. The income data was not collected as a continuous variable, but as categorical, which 80% of participants reported a household income under $60,000 per year. Participants were provided with 7 income categories $15,000 per year or less (19.56%); $15,001-$30,000 per year (16.3%); $30,001-$45,000 per year (23.9 %); $45,001-$60,000 per year (20.6 %); $60,001-$75,000 per year (5.43%); $75,001-$90,000 per year (6.52 %); $90,000 per year or over USD (7.6 %). Therefore $45,0001-$60,000 per year USD (U.S. Census income median) was used as a cutoff to identify low-income versus high-income. Overall, the average intake of each micronutrient under investigation was higher among those participants with annual income of $60,000 USD or less compared to participants with annual household income greater than $60,000 USD. Except vitamin E, none of the differences in average intake of these micronutrients between two income groups were statistically significant (p-value > 0.05). The low-income group had higher mean intake of vitamin E (9 mg/day) compared to participants with high-income group (7.0 mg/day). This difference was statistically significant.

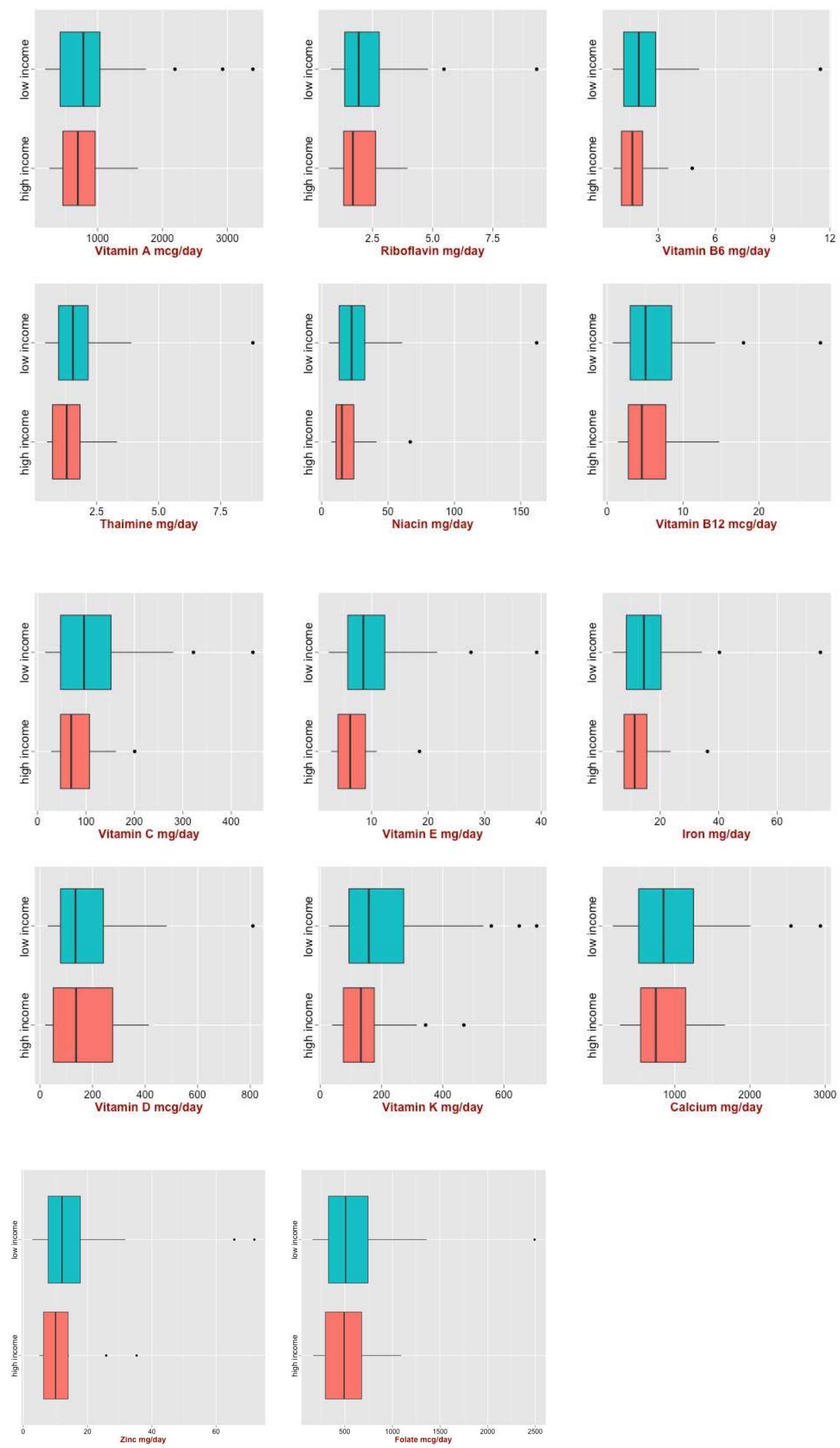


Figure 1. Distribution of micronutrients by household income level.

Table 10

Comparison of Mean Intake of Micronutrients Among High and Low Income Groups

	High household income	Low household income			
Micronutrient	Mean (*SD*)	Mean (*SD*)	*t*-statistic	*p*-value	95% CI of mean difference
Vitamin A[#§]	745.5 (372.7)	858.0 (560.5)	-1.03	0.31	(-333.9, 108.9)
Thiamine[*]	1.4 (0.8)	1.8 (1.2)	-1.66	0.105	(-0.8, 0.1)
Riboflavin[*]	1.9 (1.0)	2.2 (1.3)	-1.00	0.323	(-0.8, 0.3)
Niacin[*]	20.2 (14.4)	25.8 (20.8)	-1.34	0.188	(-14.1, 2.9)
Vitamin B6[*]	1.8 (1.0)	2.2 (1.6)	-1.47	0.151	(-1.1, 0.2)
Vitamin B12[#]	5.4 (3.5)	6.3 (4.4)	-0.86	0.394	(-2.8, 1.1)
Vitamin C[*]	84.5 (48.0)	112.9 (81.8)	-1.92	0.061	(-58.2, 1.4)
Vitamin D[#]	172.4 (130.8)	172.6 (132.6)	-0.01	0.995	(-71.1, 70.6)
Vitamin E[*£]	7.0 (3.9)	9.9 (6.1)	-2.52	0.016[^]	(-5.2, -0.6)
Vitamin K[#]	153.9 (115.6)	202.3 (151.2)	-1.49	0.145	(-114.4, 17.6)
Iron[*]	13.1 (7.7)	16.5 (11.1)	-1.55	0.129	(-7.9, 1.1)
Calcium[*]	830.8 (415.2)	946.3 (541.6)	-0.99	0.328	(-352.4, 121.3)
Zinc[*]	11.7 (7.7)	14.6 (11.5)	-1.27	0.212	(-7.4, 1.7)
Folate[#€]	516.5 (263.5)	612.9 (394.7)	-1.25	0.22	(-252.7, 60.0)

Note. [#] micronutrients measured in μg/day, * micronutrient measured in mg/day, [§] as retinol activity equivalents (RAEs), [£] as α-tocopherol, [€]as dietary folate equivalents (DFE), [^]*p*-value < 0.05.

Stress comparison. Comparison of the mean intake of micronutrients among participants with high-stress and low-stress-levels are shown in Table 11. Figure 2 shows differences in the distribution of micronutrient levels among high-stress level and low-stress-level. The mean intake levels of thiamine, niacin, vitamin B6, vitamin B12, vitamin C, vitamin E, vitamin K, iron, zinc and folate were higher among participants with low stress compared to participants with high stress. Results of the two-sided *t*-tests show that these differences are not statistically significant (p-values > 0.05). The average intake of vitamin A, vitamin D, and calcium was higher among participants with high stress compared to participants with low stress. However, the two-sided *t* tests did not show any significant difference (p-values > 0.05).

Table 11

Comparison of Mean Intake of Micronutrients Among High and Low Stress Groups

	Low stress	High stress			
Micronutrient	Mean (*SD*)	Mean (*SD*)	*t*-statistic	*p*-value	95% CI of mean difference
Vitamin A[#§]	830.7 (592.4)	838.7 (499.2)	-0.06	0.95	(-257.0, 241.1)
Thiamine[*]	1.9 (1.5)	1.6 (0.9)	0.74	0.46	(-0.4, 0.8)
Riboflavin[*]	2.2 (1.6)	2.2 (1.1)	0.05	0.96	(-0.6, 0.7)
Niacin[*]	27.5 (27.6)	23.3 (14.3)	0.79	0.44	(-6.5, 14.9)
Vitamin B6[*]	2.4 (2.0)	2.1 (1.2)	0.78	0.44	(-0.5, 1.1)
Vitamin B12[#]	6.3 (5.1)	6.1 (3.8)	0.20	0.85	(-1.9, 2.3)
Vitamin C[*]	127.7 (89.9)	97.0 (68.0)	1.67	0.10	(-6.2, 67.6)
Vitamin D[#]	160.3 (107.4)	178.8 (142.6)	-0.70	0.49	(-71.4, 34.3)
Vitamin E[*£]	9.6 (7.2)	9.1 (5.0)	0.37	0.72	(-2.4, 3.4)
Vitamin K[#]	197.5 (167.5)	190.5 (134.6)	0.20	0.84	(-62.6, 76.6)
Iron[*]	16.7 (13.1)	15.4 (9.2)	0.47	0.64	(-4.0, 6.5)
Calcium[*]	908.3 (566.8)	931.5 (498.1)	-0.19	0.85	(-264.0, 217.6)
Zinc[*]	14.4 (12.6)	13.8 (10.0)	0.20	0.84	(-4.7, 5.8)
Folate[#€]	618.6 (442.7)	581.5 (336.1)	0.41	0.68	(-144.6, 218.9)

Note. [#] micronutrients measured in µg/day, * micronutrient measured in mg/day, [§] as retinol activity equivalents (RAEs), [£] as α-tocopherol, [€] as dietary folate equivalents (DFE).

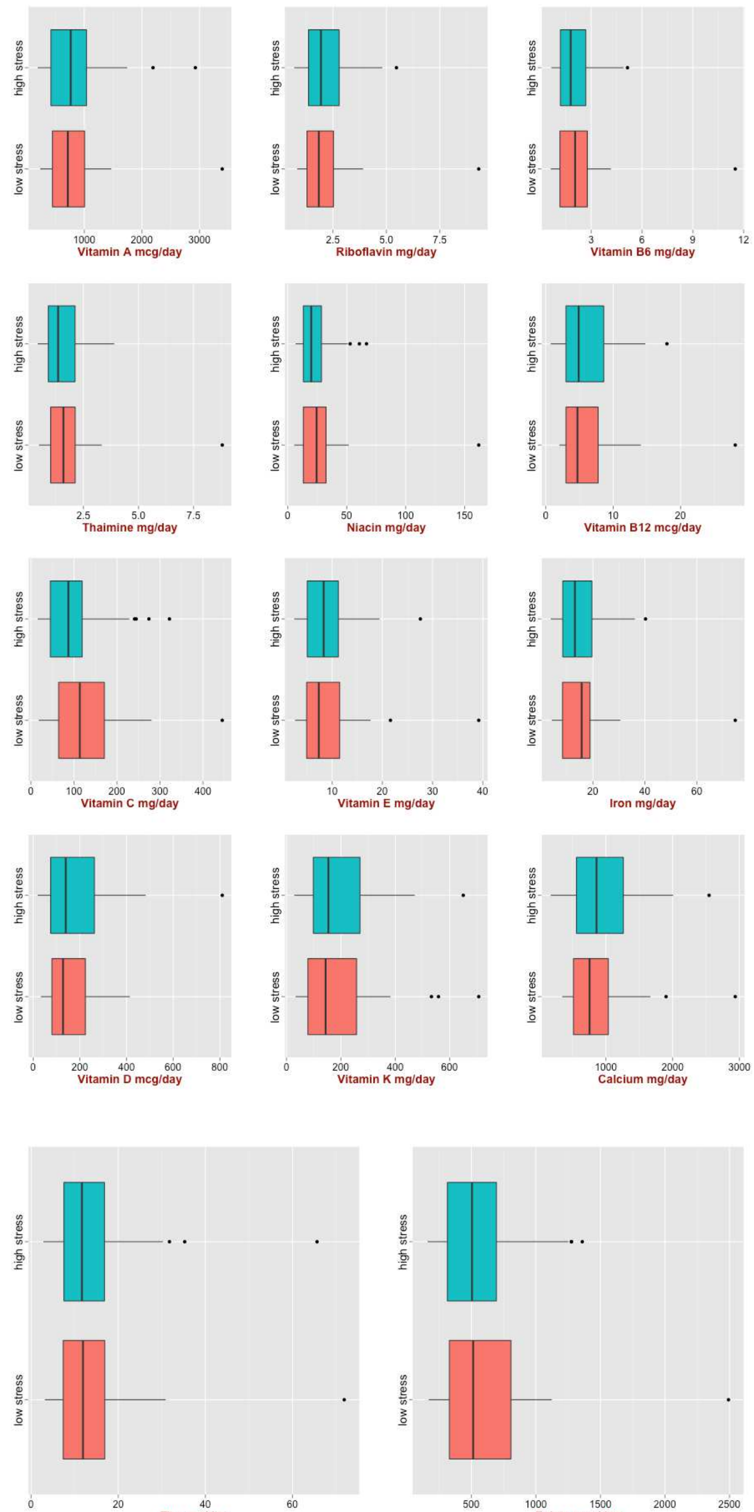


Figure 2. Distribution of various micronutrients by stress level.

Mann-Whitney U Analyses

Figures 1 and 2 show that micronutrient levels are not normally distributed. The distribution of each micronutrient level is right skewed (positively skewed). As the normality assumption is not satisfied by the outcome variables, nonparametric tests were used to evaluate hypotheses 2 and 3. The Mann-Whitney U test was used to compare median micronutrient intake levels by income level as well as by stress level (see Table 12). Median intake of vitamin E was significantly different among high-income levels compared to low-income level. There was no statistically significant difference in median intake levels of any remaining micronutrients when compared between high-income versus low-income groups, as well as low stress versus high stress groups. Median micronutrient levels were also compared among males and females by nonparametric Mann-Whitney U test (see Table 13). Although the results confirmed that the median micronutrient intake among females is significantly lower when compared to males, overall the micronutrient levels among this sample population was higher than the recommended daily allowance. The finding indicates that the sample of allied health and nursing students seem to have a healthier nutritional diet.

Table 12

Mann-Whitney U Test Comparing Median Micronutrient Intake Level by Stress Level and Household Income Level

	High income vs. low income	Low stress vs. high stress
Micronutrient	*p*-value	*p*-value
Vitamin A[#§]	0.56	0.77
Thiamine[*]	0.23	0.73
Riboflavin[*]	0.52	0.72
Niacin[*]	0.17	0.63
Vitamin B6[*]	0.22	0.65
Vitamin B12[#]	0.49	0.94
Vitamin C[*]	0.27	0.09
Vitamin D[#]	0.85	0.81
Vitamin E[*£]	0.034[$]	0.87
Vitamin K[#]	0.21	0.75
Iron[*]	0.22	0.82
Calcium[*]	0.53	0.65
Zinc[*]	0.27	0.99
Folate[#€]	0.48	0.82

Note. [#] micronutrients measured in µg/day, * micronutrient measured in mg/day, [§] as retinol activity equivalents (RAEs), [£] as α-tocopherol, [€] as dietary folate equivalents (DFE), [$] *p*-value < 0.05.

Table 13

Mann-Whitney U Test Comparing Median Micronutrient Intake Level by Stress Level and Household Income Level

Micronutrient	Male	Female	*p*-value
Vitamin A$^{\#\S}$	865.54	699.57	0.01$^{\$}$
Thiamine	1.98	1.25	0.01$^{\$}$
Riboflavin*	2.4	1.67	0.01$^{\$}$
Niacin*	25.82	17.3	0.01$^{\$}$
Vitamin B6*	2.5	1.58	0.01$^{\$}$
Vitamin B12$^{\#}$	6.9	4.08	0.001$^{\$}$
Vitamin C*	119.69	74.95	0.001$^{\$}$
Vitamin D$^{\#}$	173.09	106.96	0.01$^{\$}$
Vitamin E$^{*£}$	9.6	7.95	0.23
Vitamin K$^{\#}$	157.64	145.33	0.61
Iron*	17.16	11.78	0.01$^{\$}$
Calcium*	1075.37	804.56	0.01$^{\$}$
Zinc*	14.76	9.92	0.01$^{\$}$
Folate$^{\#€}$	622.19	456.78	0.001$^{\$}$

Note. $^{\#}$ micronutrients measured in µg/day, * micronutrient measured in mg/day, § as retinol activity equivalents (RAEs), $^{£}$ as α-tocopherol, $^{€}$as dietary folate equivalents (DFE), $^{\$}$ p-value < 0.05.

Perceived Stress Scale

The 10-item Perceived Stress Scale (PSS-10) was used in this study to measure the level of perceived stress in participants (see Table 14). Score higher than 16-20 are considered to have “Slightly Higher than Average” perceived stress levels and “High” health concern levels, while scores higher than 21 and over are “Much Higher than Average” perceived stress levels and “Very High” health concern levels. This study found 22.8% of the students scored “Slightly Higher than Average” perceived stress levels and 42.4% scored “Much Higher than Average” perceived stress levels. Both groups scored high health concern levels (see Table 15).

Table 14

Perceived Stress Scale

Question	Scale	*N* (%)
Q1. In the last month, how often have you been upset because of something that happened unexpectedly?	0= Never	3 (2.6%)
	1= Almost Never	26 (22.6%)
	2= Sometimes	39 (33.9%)
	3= Fairly Often	26 (22.6%)
	4Very Often	21 (18.3%)
Q2. In the last month, how often have you felt that you were unable to control the important things in your life?	0= Never	15 (13.0%)
	1= Almost Never	27 (23.5%)
	2= Sometimes	38 (33.0%)
	3= Fairly Often	19 (16.5%)
	4= Very Often	16 (13.9%)
Q3. In the last month, how often have you felt nervous and stressed?	0= Never	1 (0.9%)
	1= Almost Never	14 (12.2%)
	2= Sometimes	20 (17.4%)
	3= Fairly Often	30 (26.1%)
	4= Very Often	50 (43.5%)
Q4. In the last month, how often have you felt confident about your ability to handle your personal problems?	0= Very Often	25 (21.7%)
	1= Fairly Often	44 (38.3%)
	2= Sometimes	39 (33.9%)
	3= Almost Never	6 (5.2%)
	4= Never	1 (0.9%)

(*table continues*)

Question	Scale	*N* (%)
Q5. In the last month, how often have you felt that things were going your way?	0= Very Often	10 (8.7%)
	1= Fairly Often	46 (40.0%)
	2= Sometimes	44 (38.3%)
	3= Almost Never	12 (10.4%)
	4= Never	3 (2.6%)
Q6. In the last month, how often have you found that you could not cope with all the things that you had to do?	0= Never	14 (12.2%)
	1= Almost Never	29 (25.2%)
	2= Sometimes	39 (33.9%)
	3= Fairly Often	26 (22.6%)
	4= Very Often	7 (6.1%)
Q7. In the last month, how often have you been able to control irritations in your life?	0= Very Often	15 (13.0%)
	1= Fairly Often	50 (43.5%)
	2= Sometimes	37(32.2%)
	3= Almost Never	9 (7.8%)
	4= Never	4 (3.5%)
Q8. In the last month, how often have you felt that you were on top of things?	0= Very Often	22 (19.1%)
	1= Fairly Often	40 (34.8%)
	2= Sometimes	38 (33.0%)
	3= Almost Never	13 (11.3%)
	4= Never	2 (1.7%)

(*table continues*)

Question	Scale	*N* (%)
Q9. In the last month, how often have you been angered because of things that were outside of your control?	0= Never	5(4.3%)
	1= Almost Never	33 (28.7%)
	2= Sometimes	37 (32.2%)
	3= Fairly Often	21 (18.3%)
	4= Very Often	19 (16.5%)
Q10. In the last month, how often have you felt difficulties were piling up so high that you could not overcome them?	0= Never	22 (19.1%)
	1= Almost Never	38 (33.0%)
	2= Sometimes	21 (18.3%)
	3= Fairly Often	20 (17.4%)
	4= Very Often	14 (12.2%)

Table 15

Perceived Stress Level Count and Health Concern Level Percent

	Health concern level	Count	Percent
1= 0-7 (Much Lower than Average)	1=0-7 (Very Low)	8	8.7%
2= 8-11 (Slightly Lower than Average)	2= 8-11 (Low)	10	10.9%
3=12-15 (Average)	3= 12-15 (Average)	14	15.2%
4= 16-20 (Slightly Higher than Average)	4= 16-20 (High)	21	22.8%
5= 21 and Over (Much Higher than Average)	5= 21 and Over (Very High)	39	42.4%

Reliability analysis was performed on the perceived stress data collected from 92 study participants using perceived stress survey (PSS). Cronbach's alpha was 0.907 for the PSS using current study data (see Table 16), which indicates a high level of internal consistency for this scale. Table 17 shows Item-Total correlation and Cronbach's alpha if the item was deleted. By removing any question in this scale, a lower Cronbach's alpha would occur; therefore, no questions were removed.

Table 16

Reliability Analysis for Perceived Stress Scale

Cronbach's alpha	Cronbach's alpha based on standardized items	Number of items
0.907	0.906	10

Table 17

Item-Total Statistics for Perceived Stress Scale

Question in PSS	Scale mean if item deleted	Scale variance if item deleted	Corrected item-total correlation	Squared multiple correlation	Cronbach's alpha if item deleted
q1	16.79	51.924	0.709	0.643	0.895
q2	17.1	49.342	0.784	0.667	0.890
q3	16.14	53.024	0.665	0.556	0.898
q4	17.87	56.642	0.586	0.463	0.903
q5	17.5	57.132	0.535	0.461	0.905
q6	17.25	51.574	0.768	0.623	0.891
q7	17.68	55.933	0.559	0.385	0.904
q8	17.7	54.785	0.635	0.52	0.900
q9	16.97	53.043	0.646	0.521	0.899
q10	17.37	48.983	0.772	0.657	0.891

Multiple Linear Regression

Multiple linear regression models were fit with specific micronutrients as an outcome variable and income level, stress level, age group, and gender as independent variables. Each regression model predicted average intake of a specific micronutrient with presence (or absence) of independent variables. The equation for these multiple linear regression models would be written as follows:

Average micronutrient level = intercept + Income_Level + Stress_Level + Age_Group + Gender.

Results of these multiple linear regression models are shown in Table 18. None of the results showed a statistically significant association between either stress level or income level and level of micronutrient intake after adjusting for effects of age and gender. Only gender was significantly associated with an average intake of vitamin A, thiamin, riboflavin, niacin, vitamin B6, vitamin B12, vitamin C, vitamin D, iron, calcium, zinc and folate. On average female participants have a lower intake of above-mentioned micronutrients compared to male participants.

Table 18

Beta Estimates of Linear Regression Models

Micronutrient	Intercept	High stress	Low income	Age above 30 yrs.	Female
Vitamin A#§	907.3	133.2	120.7	-23.4	**-375.3~**
Thiamine*	1.9	0.0	0.4	-0.1	**-0.7~**
Riboflavin*	2.3	0.3	0.3	0.0	**-0.8~**
Niacin*	28.3	-0.6	5.5	-2.0	**-10.6~**
Vitamin B6*	2.4	0.0	0.4	-0.1	**-0.9~**
Vitamin B12#	6.8	0.8	0.9	0.1	**-3.0~**
Vitamin C*	127.6	-10.4	27.3	10.3	**-58.5~**
Vitamin D#	188.6	43.8	3.0	11.8	**-77.6~**
Vitamin E*£	8.6	0.4	2.9	-0.7	-2.6
Vitamin K#	157.1	10.6	48.7	53.0	-42.7
Iron*	16.9	1.0	3.5	-0.5	**-6.5~**
Calcium*	958.0	152.1	124.8	48.6	**-380.0~**
Zinc*	14.9	2.1	3.0	1.1	**-7.6~**
Folate#€	640.3	49.2	98.7	26.8	**-252.3~**

Note. # micronutrients measured in μg/day, * micronutrient measured in mg/day,§ as retinol activity equivalents (RAEs), £ as α-tocopherol, €as dietary folate equivalents (DFE), ~***p*-value < 0.05.**

Additionally, a linear regression model was constructed with stress level, income level, gender, age, race/ethnicity and type of allied health program in which a student is enrolled as independent variables. The equation for the multiple linear regression model is:

Average micronutrient level = intercept + Income_Level + Stress_Level + Age + Gender + Race + Type_of_program.

Fourteen different multiple linear regressions were fit using each micronutrient as outcome variable and stress level, income level, gender, age, race/ethnicity, and type of allied health program as predictor/independent variables. After fitting each regression model, detailed regression diagnostics were run, and influential observations were identified. Then regression models were re-fitted after removing any influential observations, if necessary. More detailed information about regression diagnostic and its results can be found in Appendix A.

Results of these multiple linear regression models are shown in Table 19. Income level was statistically significantly associated with niacin levels at 5% significance level. Beta estimates for income level show that, after adjusting for effects of stress, age, gender, race and type of educational program mean niacin intake was higher by 7.45 mg/day among low income groups compared to high income group. Stress level was significantly associated with a mean intake of vitamin K levels (p-value < 0.05). Students with high-stress levels consumed 60.22 mg/day higher vitamin K compared to students with low-stess level after adjusting for effects of income level, age, gender, race and type of educational program. Additionally, results showed that gender was statistically significantly associated with a mean intake of almost all the micronutrient except vitamin E, and vitamin K (*p*-value < 0.05). Beta estimates show that, females had lower mean intake of vitamin A, thiamin, riboflavin, niacin, vitamin B6, vitamin B12, vitamin C, vitamin D, tron, calcium, zinc and folate compared to males. Males were used as reference in the regression model. Beta coefficients for females were below zero, showing that females have a lower intake compated to males. There was no statistically significant association between age of the participant and any micronutrient intake level (*p*-value > 0.05).

Beta estimates for nuclear medicine technology program reveal that after adjusting for effects of stress, income, age, gender and race, participants enrolled in nuclear medicine technology program had higher mean intake of vitamin K (153.74 mg /day) compared to participants enrolled in nursing programs. Likewise, enrollment in the sports medicine program was statistically associated with higher mean intake of vitamin K (95.4 mg/day) compared to students enrolled in nursing programs. Study participants enrolled in the radiology technology programs had significantly higher mean intake of vitamin K (115 mg/day) compared to student enrolled in nursing program. Regression models did not show significant association between race and various micronutrient intake levels. Similarly, students enrolled in occupational medicine did not differ significantly with students enrolled in nursing program on any micronutrient intake level after adjusting for effects of stress, income, age, gender and race.

Table 19

Beta Estimates of Multiple Linear Regression Models

Micronutrients	Intercept	High Stress	Low Income	Age.	Female	Nuclear Medicine Tech	Sports Medicine	Occupational Medicine	Radiology Tech	Hispanic/Latino
Vitamin A[#§]	1004.38	156.73	-31.3	2.73	-312.35[$]	109.96	-19.89	59.40	138.37	-258.14
Thiamine[*]	1.46	0.14	0.42	0.008	-0.59[$]	-0.42	-0.34	-0.14	-0.19	0.07
Riboflavin[*]	2.17	0.36	0.24	0.008	-0.76[$]	-0.42	-0.32	-0.08	-0.18	-0.18
Niacin[*]	16.87	1.76	7.45[$]	0.15	-8.77[$]	-3.67	-3.21	-0.98	-0.07	1.31
Vitamin B6[*]	1.76	0.17	0.41	0.01	-0.67[$]	-0.33	-0.24	-0.15	-0.04	0.1
Vitamin B12[#]	4.32	1.14	0.75	0.06	-2.63[$]	-1.75	-0.65	0.11	0.46	0.29
Vitamin C[*]	88.49	-7.04	16.14	1.2	-53.91[$]	1.14	-0.76	-7.37	17.59	6.16
Vitamin D[#]	189.66	35.76	-1.98	2.2	-90.89[$]	-65.96	-15.77	-20.03	-15.06	-35.99
Vitamin E[*£]	6.59	0.59	2.18	0.03	-1.47	-0.29	-0.65	-0.07	0.81	-0.05
Vitamin K[#]	30.33	60.22[$]	-37.73	4.84	-13.12	153.74[$]	95.4[$]	20.52	115.01[$]	-57.3
Iron[*]	14.1	1.9	4.0	0.1	-5.5[$]	-4.0	-4.1	-3.0	-1.7	0.5
Calcium[*]	961.9	162.7	114.9	5.5	-407.6[$]	-262.3	-202.1	19.6	-57.7	-124.3
Zinc[*]	9.89	1.39	2.20	0.09	-3.99[$]	-3.01	-1.89	-1.81	-0.24	1.54
Folate[#€]	518.75	80.27	108.47	4.99	-225.67[$]	-136.49	-125.49	-77.68	-54.21	-15.17

Note. [#] micronutrients measured in µg/day, * micronutrient measured in mg/day, [§] as retinol activity equivalents (RAEs), [£] as α-tocopherol, [€]as dietary folate equivalents (DFE), [$] *p*-value < 0.05. Reference groups: low stress, high income, age below 30 years, male gender, enrollment in nursing program, and race other than Hispanic/Latino are used as reference groups in above regression model.

Relationship Between Household Finances and Eating Habits

Unfortunately, there was not a controlling effect of participant living status on income level. With this in mind, an analysis was performed to look at the differences in participant's eating habits based on their finances (Table 20). Fisher's test was performed to assess if the differences are statistically significant. Due to small counts in some of the cells Fischer's test is more suitable than chi-square test for assessing differences.

Table 20

Differences in Eating Habits Due to Finances

		High finances	Low finances	*p*-value*
Do you feel like your dietary intake is based upon what you can afford?	Yes	6 (33.3)	29 (39.2)	0.94
	Sometimes	8 (44.4)	28 (38.8)	
	Never	4 (22.3)	17 (23.0)	
Do you ever find that your dietary selections are based upon price?	Yes	5 (27.8)	29 (39.2)	0.55
	Sometimes	10 (55.6)	30 (40.5)	
	Never	3 (16.7)	15 (20.3)	
How often are your dietary intake choices based upon what you can afford during the week?	Always	4 (22.2)	16 (21.6)	0.46
	Sometimes	8 (44.4)	43 (58.1)	
	Never	6 (33.3)	15 (20.3)	

Note. *p*-values for Fischer's exact test.

About 40% of students with low finances feel that there dietary intake is based upon what they can afford compared to 33% of students with high finances. Almost the same proportion of students with high and low finances (23%) never feel that their dietary intake is based upon what they can afford. The Fischer's exact test shows this difference among student with high and low finances groups are not statistically significant.

Almost 40% of students with low finances said that their dietary selections are based upon price compared to 28% of students with high finances. More than 20% of students with low finances said that their dietary selections are never based upon price compared to only 17% of students with high finances. This difference was not statistically significant (*p*-value > 0.05). Almost similar proportion of students with high and low finances (22%) responded that they always make choices about their diet based upon what they can afford during the week. However, more than 33% of the students with high finances said they never make dietary choices based upon what they can afford during the week compared to only 20 percent of students with low finances. This difference was statistically significant (*p*-value < 0.05).

Summary

Chapter 4 began with details about data collection and a descriptive analysis of the study sample. The chapter also provides descriptive statistics that characterized the study population recruited from Keiser University. The three research hypotheses were tested using *t* tests and multiple linear regression models. Comparison of average micronutrient intake among study participants with recommended daily allowances (RDA) values for those micronutrients with one-sample *t*-test showed that average micronutrient intake in study population is higher than recommended values, which could be attributed to regular intake of multivitamins by the students. In an addition, the FFQ can overestimate positive dietary choices and it may be related to overreporting of the participants interpertation of poroportions, calories, and amount of food intake. Each FFQ is analyzed using a nutrient database developed from the most recent USDA values available at the time the NutritionQuest software was created. Studies have found 24-hour recalls, or food records used to estamate dietary intake may result in misreporting (Streppel et al., 2013). According to Jackson, Walker, Younger, and Bennett (2011), FFQ's tend to overestimate energy and carbohydrate intake but gives no differences in the intake for protein, and fat. Futhermore, FFQ may vary from population to population (Streppel et al., 2013). Factors that can influence the affect of validity of the FFQ may be memory, and nutrient data (Jackson et al., 2011; Streppel et al., 2013). The number of food items, the inclusion of portion size questions, and mode of administration may also affect the validity of a FFQ (Streppel et al., 2013). However, results of two sample *t*-tests showed that there was no significant difference in average intake of micronutrients among participants with high- and low-income levels, as well as among participants with high- and low-stress-levels.

The mean total score for the prescreen survey was 12.45, with a median score of 11.0. Out of the115 participants, only 92 (80%) had a total score of 16 or less on the prescreen survey and were eligible for final data analysis. The one sample *t*-test showed that the average intake of micronutrient in study participants was significantly different compared to RDA values. However, the results of the two-sample *t* test and multiple linear regression showed that there was no significant difference in levels of average micronutrient intake among participants with high- and low-income levels, as well as among participants with high- and low-stress level.

Results of Mann-Whitney U tests (nonparametric tests) showed similar results. There was no significant difference in median intake of micronutrients levels when compared between high-income versus low-income group and low-stress versus high-stress group. Eventhough the intake of vitamin E was higher than the RDA, a signficant difference in median intake of vitamin E was observed among high-income levels compared to low-income levels. Multiple linear regression analysis corresponded with current guidelines where female students are known to have significantly lower mean micronutrient intake when compared to male students. After adjusting for effects of stress, age, gender, race and type of educational program, mean thiamin and vitamin E intake was higher among students in low-income group compared to students in high-income group. Also, linear regression results show that students enrolled in the Nuclear Medicine Teach program have lower average intake of thiamine, vitamin B12, iron and calcium when compared to students enrolled in the nursing program. The sports medicine program had lower mean daily intake of thiamine, niacin, iron, folate, riboflavin, vitamin B6, calcium and zinc when compared to mean intake among students enrolled in the nursing program.

Chapter 5 will cover the results observed in this study and compare them to previous published literature. Study limitations will be discussed, as well as study implications and recommendations for future research.

Chapter 5: Discussion, Conclusions, and Recommendations

Introduction

This study was focused on micronutrient consumption—specifically, vitamins A, B, B12, C, D, E, and K and the minerals iron, calcium, zinc, and folate—in the diets of allied health and nursing students with consideration to stress (high vs. low) and income (high vs. low) levels. In this quantitative cross-sectional study, I sought to (1) estimate micronutrient levels, (2) compare micronutrient levels to the recommended daily allowances, (3) compare the estimated micronutrient levels of high-income and low-income students, and (4) compare the estimated micronutrient levels of students with high and low stress levels in this population. This study produced limited informative negative findings due to the small study size. The results of the study demonstrated that the micronutrient values found in allied health and nursing students at Keiser University are higher than the RDA. Therefore, this population was found to be healthy. Although the population was not found to be deficient according to RDA levels, higher levels of RDA might result in health benefits in this population, which could reduce the chance of future chronic diseases.

When comparing the average micronutrient intake among study participants with RDA numbers for the same micronutrients, the one-sample *t*-test showed that the average micronutrient intake in this study population was higher than RDA values. However, the results of two sample *t*-test indicated that there was no significant difference in average intake of micronutrients between participants with high and low-income-levels as well as between participants with high and low-stress levels. Similar results were observed with nonparametric Mann-Whitney U tests. There was no significant difference in the average intake of micronutrient levels when comparing high-income versus low-income and low-stress versus high-stress groups. The only significant difference was seen in the average intake of Vitamin E observed among high-income-level participants when compared to low-income-level participants. Multiple linear regression analysis showed that female students had significantly mean intake of vitamin A, thiamin, riboflavin, niacin, vitamin B6, vitamin B12, vitamin C, vitamin D, iron, calcium, zinc, and folate compared to male students.

Interpretation of Findings

Poor dietary habits are a major public health concern. Unhealthy habits may lead to chronic diseases such as cardiovascular disease and cancer (Ames, 2006; Black, 2003; Sriram & Lonchyna, 2009). A diet rich in total fat, saturated fat, and cholesterol but low in unsaturated fats, fruits, and vegetables has been associated with the development of cardiovascular risk factors. It is assumed that medical students practice healthy dietary habits, given the nature of their future careers, when compared to nonmedical students (Ganasegeran et al., 2012; Rao et al., 2012; Sajwani et al., 2009). A research study in China, however, demonstrated that medical students displayed early risk factors that contribute to chronic diseases due to poor dietary habits (Sakamaki et al., 2005). Furthermore, other studies have shown that although medical students are knowledgeable of what good dietary habits consist of, this knowledge is not applied into their practice (Ganasegeran et al., 2012; Rubina et al., 2009). Diet intake has been assessed using various methods that include dietary record, 24-hour dietary recall, food frequency questionnaire (FFQ), and diet history. The FFQ has been one of the most common methods used to find an association between diet intake and diseases; it features easy administration and is relatively inexpensive in studies with large sample sizes (Sauvagoeot, Alkerwi, Adelin, & Guillaume, 2013). The FFQ was used in this study to measure dietary intake and micronutrient levels in allied health and nursing students. The one-sample *t*-test showed that the average micronutrient intake was higher than the recommended daily allowance values for micronutrients.

This study aimed to verify or disprove the research hypotheses as stated above. In a similar manner to previous quantitative research using the positivist paradigm, this study used predesigned data collection methods with controlled measurements. The goal of this study was to conduct an objective study through the use of a survey with precisely worded questions and statistical analysis, as suggested by Ulin et al. (2005). The postpositivist theoretical framework describes the methodology of acquiring truth from the respondents during an interview, especially when studying the actions of human behaviors and reflecting on the need to examine the factors that influence outcome behavior (Creswell, 2009). This framework assists in using specific entity of the population to understand the human elements that involve students in behaviors that contribute to a lack of acquiring micronutrients so that all students, irrespective of race/ethnicity, can achieve optimal outcomes free of micronutrient deficiency.

Independent Variable (Income)

In this study, 38.0% of the students felt that their dietary intake was based upon what they could afford, while 55.4% of the students responded that “sometimes” these choices depended upon what they could afford during the week. Among the students, 43.5% responded that “sometimes” their dietary selections were based upon price. This concurs with the Ganasegeran et al. (2012) study; food choices were based upon the cost of food and availability of fast food for university students.

The average intake of each micronutrient under investigation in this study was higher among those participants with annual income of less than \$45,000 to \$60,000 USD compared to participants with annual household income greater than \$60,000 USD. Except for vitamin E, none of the differences in average intake of these micronutrients between the two income groups were statistically significant (p-value > 0.05).

The results of the two sample t-test showed no statistically significant difference in the average intake of micronutrients by income level (high vs. low) or stress level (high vs. low). Based on the nonnormal distribution of the outcome variables, Hypotheses 2 and 3 were also evaluated by using a Mann-Whitney U test to compare median micronutrient intake levels to income levels and stress levels. The results of this nonparametric testing rejected the second null hypothesis (p-value < 0.05) suggesting that the low-income group had significantly higher mean intake of vitamin E (9.9 mg/day) compared to participants in the high-income group (7.0 mg/day).

This study involved 14 micronutrients as outcome variables; significant differences were found for some of the micronutrients, whereas other micronutrients had no significant differences. The following is the interpretation of results using null/alternative hypotheses:

1. Are there differences between micronutrient intake levels in allied health and nursing students at Keiser University on the Miami, FL campus when RDA levels are compared?

$H0_1$: There is no significant difference between the levels of micronutrients estimated in a sample of first-year allied health and nursing students and the recommended daily allowance (RDA) for each micronutrient.

Ha_1: There are differences between the levels of micronutrients estimated in a sample of first-year allied health and nursing students and the recommended daily allowance (RDA) for these micronutrients.

The average intake of each micronutrient among the study population was higher than the RDA value (see Table 10). The *t*-test results showed significant *p*-values (< 0.05) for all the micronutrients. This finding rejects the first null hypothesis and supports the conclusion that there is a statistically significant difference in the levels of micronutrients estimated in a sample of first-year allied health and nursing students and the RDA for each micronutrient . This study found no micronutrient differences that were a disadvantage for the allied health students. The statistically significant difference found in this study was higher than the RDA for all nutrients, which indicates a healthy population.

2. Do micronutrient levels in allied health and nursing students at Keiser University on the Miami, Florida, campus differ by their income status?

   $H0_2$: There is no significant difference between the levels of micronutrients estimated in a sample of low-income first-year allied health and nursing students and the levels of high-income students.

   Ha_2: There are differences between the levels of micronutrients estimated in a sample of low-income first-year allied health and nursing students and the levels of high-income students.

The average intake of only vitamin E was higher among the low-income group compared to the higher income group (see Table 10, Table 12, and Table 19). This difference was statistically significant (*p*-value = 0.016). The second null hypothesis for vitamin E was rejected, and it was concluded that there is a significant difference between the levels of vitamin E estimated in a sample of low-income first-year allied health and nursing students and those of high-income students. However, the *p*-value was nonsignificant for other micronutrients; thus, the null hypothesis for all other micronutrients was not rejected.

3. Do micronutrient levels in allied health and nursing students at Keiser University on the Miami, FL campus differ by stress level?

   $H0_3$: There is no significant difference between the levels of micronutrients estimated in a sample of low-stress first-year allied health and nursing students and the levels of high-stress students.

   Ha_3: There are differences between the levels of micronutrients estimated in a sample of low-stress first-year allied health and nursing students and the levels of high-stress students.

In the evaluation of the third hypothesis, none of the *p*-values was significant for *t* tests (all *p*-values > 0.05; see Table 11, and Table 19). The data analysis failed to reject the third null hypothesis, and it was concluded that there was no statistically significant difference between the levels of micronutrients estimated in a sample of low-stress first-year allied health and nursing students and those of high-stress students.

Independent Variable (Stress)

The stress of university life and a medical study load may be factors that negatively influence students' dietary habits (Dyrbye et al., 2006; Ganasegeran et al., 2012; Kushner et al., 2011; Mikolajczk, El Ansari, & Maxwell, 2009). To measure psychological stress in this study, the Perceived Stress Scale (PSS) was used and consisted of 10 questions (Cohen, 1988, 1992; Cohen & Janicki-Deverts, 2012; Cohen et al., 1983), as reported in Table 16. A Cronbach's alpha of 0.907 was obtained from the sample students (see Table 17). Furthermore, the results of the PSS for the allied health and nursing students demonstrated that more than 60% of the studied sample perceived that stress levels could lead to health concerns. Table 15 demonstrated that 22.8% perceived stress slightly higher than average, while 42.4% perceived stress much higher than average, which may lead to high levels of health concern. According to Cohen and Janicki-Deverts (2012), psychological stress may lead to unhealthy practices, an increase in disease, an acceleration of disease progression, and symptoms that could lead to an increase of health service use and even mortality.

The mean intake levels of thiamine, niacin, vitamin B6, vitamin B12, vitamin C, vitamin E, vitamin K, iron, zinc, and folate were higher among participants with low stress compared to participants with high stress. The results of two-sided t-tests demonstrated that these differences are not statistically significant (p-values > 0.05). However, the average intakes of vitamin A, vitamin D, and calcium were higher among participants with stress compared to participants with low stress. The two-sided t tests did not show any significant difference (p-values > 0.05).

Independent Variables (Gender, Age, Program Type)

Multiple linear regression analysis corresponded with current guidelines where female students have significantly lower mean micronutrient intake compared to male students. Seabolt et al. (2012) indicated that 87.3% of the males had lower micronutrient intake of vitamin E, vitamin D, calcium, magnesium, and potassium, while 51.8% of the females had lower micronutrient levels for vitamin D, vitamin E, calcium potassium, magnesium, and iron. The female participants in this study had statistically significant lower mean intake of vitamin A, thiamin, riboflavin, niacin, vitamin B6, vitamin B12, vitamin C, vitamin D, iron, calcium, zinc, and folate when compared to male participants. The study results also showed that students enrolled in the nuclear medicine technology program and sports medicine program had significantly higher intake of vitamin K when compared to students enrolled in the nursing program ($p < 0.05$).

Limitations of the Study

Originally, a priori power analysis was computed to establish the required sample size, given α, power, and effect size of 95 total participants. A small effect size of 0.25 was assumed, along with a power of 0.80 (1-β error probability) and alpha of error probability of 0.05. This study resulted in limited informative negative findings due to the small study size; only 92 students of the required 95 students were included for the final analysis. Lower power due to lower sample size groups resulted in inadequate statistical power to adequately test research questions. This makes interpreting the data difficult in the absence of statistically significant findings. In the case where there are statistically significant findings, the results show that the mean nutrient intake is higher than the RDA. This statistically significant finding could be due to the nutritional software, which usually overestimates the results unless the sample size is significantly increased. A post hoc power analysis was done to achieve a 66% total power with a small effect size of 0.25 and alpha error probability of 0.05, two-sided one sample *t* test, and 92 total participants. As discussed in Chapter 4, the mean level of each micronutrient (vitamins A, B, B12, C, D, E, K, thiamine, riboflavin, niacin, iron, calcium, zinc, and folate) was compared with the RDA value for each micronutrient.

As with any self-reported research study, data from the study participants are referenced as self-reported data. A consistent limitation in this study was collecting sufficient data for the specific questions, protocols, and guidelines. There were designated guidelines that had to be followed for data abstraction and to verify the manner in which the data were reported, which resulted in challenges. Another study limitation was that there was no simple or feasible way to find actual students interested in participating in the study. Due to low enrollment of students in the medical assistance program, there were no participants from this program. Another limitation to this study was the students' honesty in disclosing their micronutrient consumption and consistency. Data accuracy was a limitation because results may not reflect proper nutrient intake for the population represented by these study participants. Furthermore, using inaccurate data could result in inaccurate findings, which also represents a limitation in collecting data, and further investigations or analyses that could be used to develop motivation programs to increase micronutrient consumption and consistency.

Recommendations

This study was conducted on one campus of Keiser University, which may limit the generalizability of the results, and may only be internally valid because of the test subjects. One solution to limit generalizability is to perform a greater number of observations, which increases the sample population; precision can be reasonably maintained due to random errors averaging out between studies. As this research was only conducted with students in healthcare fields, the results of this study cannot be used among students in other majors. Testing the influence of the variables of this study on other campuses and within a more representative sample could increase the generalizability of the study. Another recommendation would be to include students majoring in similar fields from another college/university outside of Keiser University. Comparing representative samplings of students from two different universities and comparing the micronutrient intake in these students in relation to RDA recommendations could determine further generalizability.

Implications for Social Change

I anticipated using the study results to contribute to the literature in this area, in addition to furthering positive social change. Generated data from this study can be used to demonstrate the health benefits of some nutrients at intake levels greater than the RDA. This may improve the quality of life of allied health and nursing students and develop motivational health programs that will create awareness for this population. Negative findings from this study can be used by other researchers when considering applications of generalizability. Researchers must (1) determine if a aspect in the selected population actually generated the result, (2) determine if the test group will produce the same result using different measurments, and (3) ensure that their test group is relatively large and random.

In another aspect, this study explored the level of micronutrient intake among allied health and nursing students by measuring dietary intake. The results demonstrated that the participants had a higher intake of micronutrient levels than the RDA values at the time the study was administered. This resulted a healthy population. The advantage of higher intake of nutrient levels than the RDA may achieve health benefits in this population, as well as other populations. For example, considerable studies have shown that folate can reduce the risk of neural tube defects, cardiovasclar disease, cancer and neurodegenrative disease; selenium, and vitamin C may reduce the risk of centain cancers, while vitamin E has been reported to reduce the risk of cardiovascular disease (Renwick et al., 2004).

According to Sherif et al. (2009), a highly organized assessment for risk factors related to health problems can arouse competitive interest or challenges. Moreover, adopting these principles and methodologies can assist in solving more comprehensive problems. Therefore, this study concentrated more on public health concerns related to lack of adequate nutrients: focusing on estimated micronutrient levels, comparing micronutrient levels to the recommended daily allowances, comparing the estimated micronutrient levels of high-income and low-income students, and comparing the estimated micronutrient levels of high-stress and low-stress-levels in a sample of first-year Allied Health and Nursing students from Keiser University. This study contributes to positive social change by using available current data retrieved from allied health and nursing students of Keiser University to compare micronutrient deference among allied health and nursing students if any are present, for future studies. The exploration of this targeted group fosters positive social change by identifying nutritional standing for future studies and calling attention to the need for such studies to be expanded, as even this basic parameter of the study points to the minimal necessary micronutrient guidelines for the optimal well-being and performance of this particular group.

This study also allows for its results to be made available to Keiser University policymakers, which could potentially result in subsequent action to monitor, improve, or, at the very least, call attention to micronutrient intake and its importance to student health. Advocating for awareness will call attention to potential. As discussed in Chapter 1, the adequate intake of micronutrients is important to the maintenance of a healthy body and the prevention of micronutrient deficiency related diseases (Misner, 2006; WHO, 2008). According to the WHO, iron deficiency is one of the ten most serious health problems in the modern world and a critical determinant in overall health (McLean et al., 2009; WHO, 2008). To complement WHO's iron deficiency health related problems, this study indicates that the greater the household annual income of the participants, the less the likelihood of the average intake of each micronutrient. For example, participants with income greater than $60,000 USD consumed less micronutrients compared with participants earning less than $45,000 to $60,000 USD. However, this difference is not applicable to vitamin E. Considering the two income groups in terms of micronutrient intake, there were no statistically significant differences (p-value > 0.05). The *t test* also indicated no statistically significant difference in the average intake of micronutrients among low-income levels versus high-income levels and low-stress levels versus high-stress levels. According to this evidence, all students need micronutrient intake awareness, regardless of income or stress levels.

Finally, this specific population of students, students who are entering into the allied health and medical fields, are especially in need of an education in the effects and benefits of sufficient micronutrient intake. Providing these students with a solid foundation in proper nutrition as they gain their education in the medical field, will not only improve their academic performance and overall health; but in turn, their overall physical and mental well-being should be improved as well. Students practicing these behaviors will also be more likely to have a positive influence regarding micronutrient intake on the patients with whom they will soon interact after graduation (Mota et al., 2013; Junqueira & Jaffe, 2012; Seabolt et al., 2012). Such a positive outcome affects not just the individual student and the student's institution, but the surrounding community as well.

Conclusion

Allied health and nursing students in this study had an average micronutrient intake more than the RDA values, reflecting positive behaviors potentially influenced by their immersion in an education regarding healthcare. In addition to modifying their own behaviors, since this particular group is entering the healthcare field, they can also assist future patients in modifying poor nutritional habits and fostering healthy micronutrient intake. As the results of this study is shared, it is the hope of the researcher to communicate the importance of this issue with the educational institutions similar to Keiser University. The educational environment of Keiser University allied health and nursing students can add to the overall importance of nutrition, and equip students with the knowledge of how to perform in their fields, as well as equip the students with the knowledge of how they can best perform as healthy human beings. Schools can accomplish this positive goal of ameliorating student nutritional health and awareness by establishing eating plans or providing access to a nutrition specialist on campus. Empowering students with this kind of knowledge, in addition to their tuition-based curriculum, will provide students with a life-long attitude toward maintaining optimal health, an attitude that will be seen by and shared with their future patients.

The final study results were compared to other literature findings. For example, Seabolt, Spence, and Silver (2012) research consisted of six-year data collection to second-year medical students. Seabolt et al. (2012) study provided a Block Brief 2000 FFQ for students to complete, while the FFQ that was provided to the allied health and nursing students in this study was Block 2005. Seabolt et al. (2012) results demonstrated that both females and males had lower intake of folate, vitamin D, vitamin E, calcium, potassium, magnesium and iron; 87.3% of males were reported to consume foods with low levels of vitamin E. Seabolt et al. (2012) research study had no significant differences found by year for demogrpaic variables and no significant changes were found in the amount of energy or macronutrients consumed.

No statistically significant differences were found in this research study, which did not produce a probabilistic model to be applied from findings. This study did demonstrate using the RDA value for micronutrient and comparing it to the mean level of each micronutrient. For example, the mean intake of vitamin A (836 µg /day), thiamine (1.7 mg/day), riboflavin (2.2 mg/day), niacin (14.7 mg/day), vitamin B6 (2.2 mg/day), vitamin B12 (6.1 µg/day), vitamin C (107.4 mg/day), vitamin D (172.6 µg/day), vitamin E (9.3 mg/day), vitamin K (192.8 µg/day), iron (15.9 mg/day), calcium (923.7 mg/day), zinc (14 mg/day), and folate (594 µg/day) among the study population was significantly different from the mean RDA values. The confidence interval (95%) suggests that the mean intake levels were higher among the study population when compared to the RDA values of each micronutrient. Overall, the results demonstrated that allied health and nursing students levels of micronutrients were higher than the RDA. This may be attribute to the FFQ overestimation of posiitve dietary choices which could be related to overreporting of the participants interpertation of proportions, calories, and amount of intake of food. Overestimation of food intake has been documented to affect the validity of a FFQ (Jackson et al., 2011; Streppel et al., 2013).

Furthemore, when comparing the average intake of these micronutrients with income levels,it demonstrated that the RDA values were higher among those participants with low-income levels than high-income levels. The difference in the average of these micronutrients was not statistically significant (p-value > 0.05). Vitamin E mean intake was higher in low-income when compared to participants with high-income. Vitamin E showed statistical significant; the confidence internal (95%) for vitamin E (9.3 mg/day) suggests that the mean intake levels were lower among the study population when compared to the RDA values.

As discussed in chapter 2, vitamin E has various functions such as being an antioxidant, enzymatic activity regulator, responsible for wound repair and regeneration of the extracellular tissue lost or damage (Villacorta, Garca-Souza, Ricciarelli, Zingg, & Azzi, 2003). Inadequate levels of vitamin E can lead to anemia, retinopathy, impariment of immune response and male infetertility being some of the the clinical signs of malnutrition (Khokhar, & Lipman, 2012; NIH, 2012).

The two-sided t-tests showed no statistically significant (*p*-values > 0.05) when compared to the mean intake levels of thiamine, niacin, vitamin B6, vitamin B12, vitamin C, vitamin E, vitamin K, iron, zinc and folate with high-stress levels to low-stress levels. However, the average intake of vitamin A, vitamin D, and calcium was found to be higher in participants with high-stress levels than those participants with low-stress levels. Therefore, the two-sided *t* test did not show any significant difference (*p*-values > 0.05).

The results of the multiple linear regressions showed no statistical significant association between stress levels, income levels and micronutrient intake levels after adjustments for age and gender effects. Although the beta estimates showed that the average female participants had a lower intake of vitamin A, thiamin, riboflavin, niacin, vitamin B6, vitamin B12, vitamin C, vitamin D, iron, calcium, zinc and folate when compared to male participants. Beta estimates for income level were adjusted for effects of stress, age, gender, race and type of educational program mean. Niacin intake was higher in low-income when compared to high-income participants, while high-stress-level was significantly associated with a mean intake of vitamin K when compared to low-stress-level participants. The Beta estimates for type of educational program, showed that nuclear medicine technology, sports medicine, radiology technology and occupational medicine had higher mean intake of vitamin K when compared to nursing programs of vitamin K after adjusting the effects of stress, income, age, gender and race.

A regression diagnostic was used for the 14 different multiple linear regressions. Cook's distance and hat statistic was used to identify influential observations for each of the micronutrients. Each micronutrient was used as an outcome (vitamin A , thiamine , riboflavin , niacin , vitamin B6 , vitamin B12 , vitamin C, vitamin D , vitamin E, vitamin K, iron, calcium, zinc, folate) and stress level, income level, age, race/ethnicity and type of educational program was fit as the predictor/independent variables (see Appendix A).

The study sample micronutrients levels were higher than the RDA. Understanding the health benefits of higher intake levels of several nutrients than the RDA, may reduce health conditions, such as elevated cholesterol levels, heart diseases, and hypertension, and even obesity, and other issues related to body image that can affect a healthcare worker's attitude and relationship with his or her patients.

For example, diary food groups contributes to the intake of many nutrients such has more than 50% of the total vitamin D and calcium, and more than 25% of vitamin A, vitamin B12, and phosphorus (Rice, Quann & Miller, 2013). The higher levels of diary foods intake has been reported to improve bone health, reduce risk of cardiovascular diesease, type 2 diabetes and lower blood pressure in adults (Rice, Quann & Miller, 2013). In addition, this study can be used as an additional guide to increase the body of literature, and knowledge content of micronutrient education in the allied health and nursing school programs. It is important to enhance allied health and nursing students' preparedness as future health care providers to serve as role models, particularly for sustainable, healthy dietary behaviors and to better recognize the nutritional needs of their future patients.

References

Abner, E. L., Schmitt, F. A., Mendiondo, M. S., Marcum, J. L., & Kryscio, R. J. (2011). Vitamin E and all-cause mortality: A meta-analysis. *Current Aging Science*, *4*(2), 158–170. doi:10.2174/1874609811104020158.

Adams, J. S., & Hewison, M. (2010). Update in Vitamin D. *Journal of Clinical Endocrinology & Metabolism, 95*(2), 471-478. doi:10.1210/jc.2009-1773

Adams, K. M., Martin, K., & Steven, H. Z. (2010). Nutrition education in US medical schools: Latest update of a national survey. *Journal of the Association of American Medical Colleges*, *85*(9), 1537-1542. doi:10.1097/ACM.0b013e3181eab71b

Ahn, T. B., Cho, J. W., & Jeon, B. S. (2004). Unusual neurological presentations of vitamin B12 deficiency. *European Journal of Neurology, 11*(5), 339-341. doi:10.1111/j.1468-1331.2004.00778.x

Ajani, U. A., Lotufo, P. A., Gaziano, J. M., Lee, I. M., Spelsberg, A., Buring, J. E., … Manson, J. E. (2004). Body mass index and mortality among US male physicians. *Annals of Epidemiology, 14(10)*, 731-739. doi:10.1016/j.annepidem.2003.10.008

Akdal, G., Yener, G. G., & Kurt, P. (2008). Treatment responsive executive and behavioral dysfunction associated with Vitamin B12 deficiency. *NEUROCASE, 14*(2), 147-150. doi:10.1080/13554790802032242.

Akikusa, J. D., Garrick, D., & Nash, M. C. (2003). Scurvy: Forgotten but not gone. *Journal of Paediatrics and Child Health, 39*(1), 75-77. doi:10.1046/j.1440-1754.2003.00093.x

Allen, L. H. (2003). Interventions for micronutrient deficiency control in developing countries: Past, present and future. *The Journal of Nutrition, 133*(11 Suppl 2), 3875S-3878S. Retrieved from http://jn.nutrition.org/content/133/11/3875S.long

Allen, L., de Benoist, B., Dary, O., & Hurrell, R. (2006). Guidelines on food fortification with micronutrients. Retrieved from http://www.who.int/nutrition/publications /guide_food_fortification_micronutrients.pdf

American Diabetes Association. (2013). Diabetes statistics. Retrieved from http://www.diabetes.org/diabetes-basics/diabetes-statistics/?loc=DropDownDB-stats

Ames, B. N. (2001). DNA damage from micronutrient deficiencies is likely to be a major cause of cancer. *Mutation Research/Fundamental and Molecular Mechanisms of Mutagenesis, 475(1-2)*, 7-20. doi:10.1016/S0027-5107(01)00070-7

Ames, B. N. (2005). Increasing longevity by tuning up metabolism. *EMBO Reports*, *6*(S1), S20-S24. doi:10.1038/sj.embor.7400426

Ames, B. N. (2006). Low micronutrient intake may accelerate the degenerative diseases of aging through allocation of scarce micronutrients by triage. *PNAS, 103*(47), 17589-17594. doi:10.1073pnas.0608757103

Ames, B. N., & Wakimoto, P. (2002). Are vitamin and mineral deficiencies a major cancer risk? *Nature Reviews Cancer, 2*,694-704. doi:10.1038/nrc886

Andres, E., Dali-Youcef, N., Vogel, T., Serraj, K., & Zimmer, J. (2008). Oral cobalamin (vitamin B12) treatment. An update. *International Journal Laboratory of Hematology, 31*(1), 1-8. doi:10.1111/j.1751-553X.2008.01115.x

Andres, E., Federici, L., Affenberger, S., Vidal-Alaball, J., Loukili, N. H., Zimmer, J., & Kaltenbach, G. (2007). B12 deficiency: A look beyond pernicious anemia. *Journal of Family Practice, 56*(7), 537-542. Retrieved from http://www.jfponline.com/Pages.asp?AID =5145

Andres, E., Kaltenbach, G., Noel, E. Noblet-Dick, M., Perrin, A. E., Vogel, T., ... Blickle, J. F. (2003). Efficacy of short-term oral cobalamin therapy for the treatment of cobalamin deficiencies related to food-cobalamin malabsorption: A study of 30 patients. *Clinical Laboratory Hematology, 25*(3), 161-166. doi:10.1046/j.1365-2257.2003.00515.x

Arora, R., Lettieri, C., & Claybaugh, J. R. (2004). The effects of residency on physical fitness among military physicians. *Military Medicine, 169(7)*, 522-525. Retrieved from http://www.ncbi.nlm.nih.gov/pubmed/15291183

Atkinson, J., Epand, R. F., & Epand, R. M. (2008). Tocopherols and tocotrienols in membranes: A critical review. *Free Radical Biology & Medicine, 44*(5), 739–764. doi:10.1016/j.freeradbiomed.2007.11.010

Azzi, A. (2007). Molecular mechanism of alpha-tocopherol action. *Free Radical Biology & Medicine, 43*(1), 16–21. doi:10.1016/j.freeradbiomed.2007.03.013

Aziz, A. S., & Hussein, L. (2005). Evaluation of vitamin B12 status in Egypt IV: Food consumption patterns among lactating mothers and their impact on the intake of the vitamin. *International Journal of Food Sciences and Nutrition, 56*(7), 455-462. doi:10.1080/02772240500414754

Babbie, E. (2002). *The basics of social research,*. Belmont, CA: Wadsworth Publishing, Cengage Learning.

Babbie, E. (2010). *The practice of social research*, Belmont, CA: Wadsworth Publishing, Cengage Learning.

Bailey, R. L., Dodd, K. W., Gahche, J. J., Dwyer, J. T., McDowell, M. A., Yetley, El. A., …Picciano, M. F. (2010). Total folate and folic acid intake from foods and dietary supplements in the United States: 2003-2006. *American Journal of Clinical Nutrition, 91*(1), 231-237. doi:10.3945/ajcn.2009.28427

Bamonti, F., Moscato, G. A., Novembrino, C., Gregori, D., Novi, C., Giuseppe, R. D., … Maiavacca, R. (2010). Determination of serum holotranscobalamin concentrations with the AxSYM active B12 assay: Cut-off point evaluation in the clinical laboratory. *Clinical Chemistry Laboratory Medicine, 48*(2), 249-253. doi:10.1515/CCLM.2010.032

Bin, Q., Hu, X., Cao, Y., & Gao, F. (2011). The role of vitamin E (tocopherol) supplementation in the prevention of stroke. A meta-analysis of 13 randomized controlled trials. *Thrombosis and Haemostasis*, *105*(4), 579–585. doi:10.1160/TH10-11-0729

Bjelakovic, G., Nikolova, D., Gluud, L. L., Simonetti, R. G., & Gluud, C. (2012). Bjelakovic, Goran. ed. Antioxidant supplements for prevention of mortality in healthy participants and patients with various diseases. *Cochrane Database of Systematic Reviews.14,*3, CD007176. doi:10.1002/14651858.CD007176.pub2

Black, R. (2003). Micronutrient deficiency—an underlying cause of morbidity and mortality. *Bulletin of the World Health Organization*, *81*(2), 79. Retrieved from http://www.ncbi.nlm.nih.gov/pmc/articles/PMC2572405/pdf/12751414.pdf

Block, G., Coyle, L. M., Hartman, A. M., & Scoppa, S. M. (1994). Revision of dietary analysis software for the health habits and history questionnaire. *American Journal of Epidemiology. 139*(12), 1190-1196. Retreived from http://www.ncbi.nlm.nih.gov/pubmed/8209877

Block, G., Hartman, A. M., Dresser, C. M., Carroll, M. D., Gannon, J., & Gardner, L. (1986). A data-based approach to diet questionnaire design and testing. *American Journal of Epidemiology, 124*(3), 453-469. Retrieved from http://www.ncbi.nlm.nih.gov/pubmed/3740045

Block, G., Woods, M., Potosky, A., & Clifford, C. (1990). Validation of a self-administered diet history questionnaire using multiple diet records. *Journal of Clinical Epidemiology, 43*(12),1327-1335. Retrieved from http://www.ncbi.nlm.nih.gov/pubmed/2254769

Bodnar, L.M., Krohm, M.A.& Simhan, H.N. (2009). Maternal vitamin D deficiency is associated with bacterial vaginosis in the first trimester of pregnancy. *The Journal of Nutrition,139*(6), 1157-1161. doi:10.3945/jn.108.103168

Bor, M. V., von Castel-Roberts, K. M., Kauwell, G. P. A., Stabler, S. P., Allen, R. H., Maneval, D. R., … Nexo, E. (2010). Daily intake of 4 to 7 µg dietary vitamin B-12 is associated with steady concentration of vitamin B-12 related biomarkers in a health young populations. *American Journal of Clinical Nutrition, 91*(3), 571-577. doi:10.3945/ajcn.2009.28082

Bourre, J. M. (2006). Effects of nutrients (in food) on the structure and function of the nervous system: update on dietary requirements for brain. Part 1: Micronutrients.

The Journal of nutrition, Health & Aging, *10*(5), 377-385. Retrieved from http://www.bourre.fr/pdf/publications_scientifiques/259.pdf

Brigelius-Flohé, R., & Davies, K. J. A. (2007). Is vitamin E an antioxidant, a regulator of signal transduction and gene expression, or a 'junk' food? Comments on the two accompanying papers: "Molecular mechanism of alpha-tocopherol action" by A. Azzi and "Vitamin E, antioxidant and nothing more" by M. Traber and J. Atkinson". *Free Radical Biology & Medicine, 43*(1), 2-3. doi:10.1016/j.freeradbiomed.2007.05.016

Butler, C. C., Vidal-Alaball, J., Cannings-John, R., McCaddon, A. Hood, K., Papaioannou, A., … Goringe, A. (2006). Oral vitamin B12 versus intramuscular vitamin B12 for vitamin B12 deficiency: a systematic review of randomized controlled trials. *Family Practice, 23*(3)*,* 279-285. doi:10.1093/fampra/cm1008.

Cahill, L. E., Chiuve, S. E., Mekary, R. A., Jensen, M. K., Flint, A. J., Hu, F. B., & Rimm, E. B. (2013). Prospective study of breakfast eating and incident coronary heart disease in a cohort of male US health professionals. *Circulation, 128(4),*337-343. doi:10.1161/CIRCULATIONAHA.113.001474

Calvaresi, E., & Bryan, J. (2001). B vitamins, cognition, and aging: A review. *Journal of Gerontology, 56B*(6), P327-P339. doi:10.1093/geronb.56.6.P327

Carmel, R. (2008). How I treat cobalamin (vitamin B12) deficiency. *Blood, 112*(6), 2214-2221. doi:10.1182/blood-2008-03-040253

Centers for Diseases Control and Prevention. (2006). IMMPaCt- international micronutrient malnutrition prevention and control program: Micronutrient Facts. Retrieved from http://www.cdc.gov/immpact/index.html

Centers for Disease Control and Prevention (2012). Chronic disease prevention and health promotion. Retrieved from http://www.cdc.gov/chronicdisease/index.htm

Chakravarty, S. (2002). Prevalence of micronutrient deficiency based on results obtained from the national pilot program on control of micronutrient malnutrition. *Nutrition Review*, *60*(5), S53-S58. doi:10.1301/00296640260130740

Christakos, S. (2012). Mechanism of action of 1,25-dyhydroxyvitamin D3 on intestinal calcium absorption. *Reviews in Endocrine & Metabolic Disorders, 13*(1), 39-44. doi:10.1007/s11154-011-9197-x

Choi, H. K., Gao, X., & Curhan, G. (2009). Vitamin C intake and the risk of gout in men-a prospective study. *Archives of Internal Medicine, 169*(5), 502–507. doi:10.1001/archinternmed.2008.606

Chui, C. H., Lau, F. Y., Wong, R., Soo, O. Y., Lam, C.K., Lee, P. W., … Cheng, G. (2001). Vitamin B12 deficiency-need for a new guideline. *Nutrition, 17*(11-12), 917-920. doi:10.1016/S0899-9007(01)00666-9

Cohen, S., & Janicki-Deverts, D. (2012). Who's stressed? Distributions of psychological stress in the United States in probability samples from 1983, 2006, and 2009. *Journal of Applied Social Psychology, 42*(6), 1320-1334. doi:10.1111/j.1559-1816.2012.00900.x

Cohen, J. (1988). *Statistical power analysis for the behavioral sciences* (2nd ed.) Hillsdale, N. J: Erlbaum.

Cohen, J. (1992) A power primer. *Psychological Bulletin, 112*(1), 155-159. doi:10.1037/0033-2909.112.1.155

Cohen, S., Kamarck, T., & Mermelstein, R. (1983). A global measure of percieved stress. *Journal of Health and Social Behavior, 24*(4), 385-396. Retrieved from http://www.psy.cmu.edu/~scohen/globalmeas83.pdf

Combs, G. F. (2008). *The Vitamins: Fundamental Aspects in Nutrition and Health* (3rd ed.). Burlington: Elsevier Academic Press.

Cordero, J. F., Do, A., & Berry, R. J. (2008). Review of interventions for the prevention and control of folate and vitamin B12 deficiencies. *Food and Nutrition Bulletin*, *29*(2), (Suppl), S188-S195. Retrieved from http://www.ncbi.nlm.nih.gov/pubmed/18709892

Couper, M., & Rowe, B. (n.d.). Evaluation of a computer-assisted self-interview (CASI) component in a CAPI survey. (unpublished paper). Retrieved from http://www.amstat.org/sections/srms/Proceedings/papers/1995_177.pdf

Cravens, D. D., & Nashelsky, J. (2007). How do we evaluate a marginally low B12 level? *Family Practice, 56*(1), 62-63. Retrieved from http://hosp.gcnpublishing.com/fileadmin/jfp_archive/pdf/5601/5601JFP_ClinicalInquiries5.pdf

Creswell, J. W. (2009). *Research design: Qualitative, quantitative, and mixed methods approaches.* Thousand Oaks, CA: Sage Publications.

Danaei, G., Ding, E. L., Mozaffarian, D., Taylor, B., Rehm, J., Murray, C. J. L., & Ezzati, M. (2009). The Preventable cause of death in the United States: comparative risk assessment of dietary, lifestyle, and metabolic risk factors. *PLoS Medicine, 6*(4), e1000058. doi:10.1371/hournal.pmed.1000058

Delanghe, J. R., Langlois, M. R., De Buyzere, M. L., Na, N., Ouyang, J., Speeckaert, M. M., &Torck, M. A. (2011). Vitamin C deficiency: more than just a nutritional disorder. *Genes & Nutrition, 6(4),* 341-346. doi:10.1007/s12263-011-0237-7

DeNavas-Walt, C., Proctor, B. D., & Smith, J. C. (2012). Income, Poverty, and Health Insurance Coverage in the United States: 2011 Current Population Reports. *United States Census Bureau. Retrieved from http://web.archive.org/web/20130112023409/http://www.census.gov/prod/2012pubs/p60-243.pdf*

Duester, G. (2008). Retinoic acid synthesis and signaling during early organogenesis. *Cell*, *134*(6), 921–931. doi:10.1016/j.cell.2008.09.002

Dyrbye, L. N., Thomas, M. R., & Shanafelt, T. D. (2006). Systematic review of depression, anxiety, and other indicators of psychological distress among U.S. and Canadian medical students. *Academic Medicine, 81*(4), 354-373. doi:10.1097/00001888-200604000-00009

Eastley, R., Wilcock, G. K., & Bucks, R. (2000). Vitamin B12 deficiency in dementia and cognitive impairment: The effects of treatment on neuropsychological function. *International Journal of Geriatric Psychiatry, 15*(3), 226-233. doi:10.1002/(SICI)1099-1166(200003)15:3<226::AID-GPS98.CO;2-K

Elberly, R., & Feldman, H. (2010). Obesity and shift work in the general population. *The Internet Journal of Allied Health Sciences and Practice, 8*(3). Retrieved from http://ijahsp.nova.edu/articles/Vol8Num3/pdf/feldman.pdf

Eby III, G. A. and Eby, K. L. (2010). Magnesium for treatment-resistant depression: a review and hypothesis. *Medical Hypotheses, 74*(4), 649-660. doi:10.1016/j.mehy.2009.10.051

Ensminger, M. E. & Ensminger, A. H. (1994). *Foods & Nutrition Encyclopedia,* Volume 1: *A to H.* 2nd Edition. Volume 1. Boca Raton, Fl. CRC Press LLC.

Fairfield, K. M., & Fletcher, R. H. (2002). Vitamins for chronic disease prevention in adults: scientific review. *JAMA, 287*(23), 3127-3129. doi:10.1001/jama.287.23.3127

Fakhrzadeh, H., Ghotbi, S., Pourebrahim, R., Nouri, M., Heshmat, R., Bandarian, F., … Larijani, B. (2006). Total plasma homocysteine, folate, and vitamin B12 status in healthy Iranian adults: The Tehran homocysteine survey (2003-2004)/ a cross-sectional population based study. *BMC Public Health, 6,*29, 1-8. doi:10.1186/1471-2458-6-29

Fitzpatrick, T. B., Basset, G. J., Borel, P., Carran, F., DellaPenna, D., Fraser, P. D., … Fernie, A. R. (2012). Vitamin deficiencies in humans: Can plant science help? *The Plant Cell, 24*(2), 395-414. doi:10.1105/tpc.111.093120

Friso, S., Lotto, V., Corrocher, R., & Choi, S. W. (2012). Vitamin B6 and cardiovascular disease. *Water Soluble Vitamins Subcellular Biochemistry, 56*, 265-290. doi:10.1007/978-94-007-2199-9_14

Fulgoni III, V. L., Keast, D. R., Bailey, R. L., & Dwyer, J. (2011). Foods, fortificants, and supplements: Where do Americans get their nutrients?. *Journal of Nutrition, 141*(10), 1847-1854. doi:10.3945/jn.111.142257

Gamal El-Din, A. M., Hassan, A. S. H., El-Behairy, S. A., & Mohamed, E. A. (2012). Impact of zinc and iron salts fortification of buffalo's milk on the dairy product. *World Journal of Dairy & Food Sciences, 7*(1),21-27. doi:10.5829/idosi,wjdfs.2012.7.1.1102

Ganz, T., & Nemeth, E. (2012). Iron metabolism: Interactions with normal and disordered erythropoiesis. *Cold Spring Harbor Perspectives in Medicine*, *2*(5), a011668. doi:10.1101/cshperspect.a011668

Ganasegeran, K., AI-Dubai, S. A.,Qureshi, A. M., AI-abed, A. A., Am, R., & Aljunid, S. M. (2012). Social and psychological factors affecting eating habits among university students in a Malaysian medical school: a cross-sectional study. *Nutional Journal, 11*,48. doi:10.1186/1475-2891-11-48

Gangwisch, J. E., Feskanich, D., Malaspina, D., Shen, S., & Forman, J. P. (2013). Sleep duration and risk for hypertension in women: results form the nurses' health study. *American Journal of Hypertension, 26*(7),903-11. doi:10.1093/ajh/hpt044

Gardyn, J., Mittelman, M., Zlotnik, J., Sela, B. A., & Cohen, A. M. (2000). Oral contraceptives can cause falsely low vitamin B12 levels. *Acta Haematologica, 104,*22-24. doi:10.1159/000041064

Garcia, O. P. (2012). Effect of vitamin A deficiency on the immune response in obesity. *Proceedings of the Nutrition Society, 71(2),* 290-297. doi:10.1017/S0029665112000079

Goh, Y. I., Bollano, E., Einarson, T. R., & Koren, G. (2007) Prenatal multivitamin supplementation and rates of pediatric cancers: a meta-analysis. *Clinical Pharmacology & Therapeutics, 81*(5), 685–691. doi:10.1038/sj.clp.6100100

Goh, Y. I., & Koren, G. (2008). Folic acid in pregnancy and fetal outcomes. *Journal of Obstetrics Gynaecology, 28*(1), 3–13. doi:10.1080/01443610701814195

Gold, K. J., Sen, A., & Schwenk, T. L. (2012). Details on suicide among US physicians: data from the national violent death reporting system. *General Hospital Psychiatry, 35*(1), 45-49. doi:10.1016/j.genhosppsych.2012.08.005

Green, R. (2008). Indicators for assessing folate and vitamin B12 status and for monitoring the efficacy of intervention strategies. *The American Journal of Clinical Nutrition, 94* (2), 666S-672S. doi:10.3945/ajcn.110.009613

Greene-Finestone, L. S., Campbell, M. K., Evers, S. E., & Gutmanis, I. A. (2005). Adolescents' low-carbohydrate-density diets are related to poorer dietary intakes. *Journal of the American Dietetic Association, 105*(11), 1783, e1-1788.e. doi:10.1016/j.jada.2005.08.014

Gross, M. D. (2005). Vitamin D and calcium in the prevention of prostate and colon cancer: new approaches for the identification of needs. *The Journal of Nutrition, 135(2),* 326-331. Retrieved from http://jn.nutrition.org/content/135/2/326.full.pdf+html

Grunberg, N. E. (1982). The effects of nicotine and cigarette smoking on food consumption and taste preferences. *Addictive Behaviors, 7(4)*, 317-331. doi:10.1016/0306-4603(82)90001-6

Ha, E. J., Caine-Bish, N., Holloman, C., & Lowry-Gordon, K. (2009). Evaluation of effectiveness of class-based nutrition intervention on changes in soft drink and milk consumption among young adults. *The Nutrition Journal, 8*,50. doi:10.1186/1475-2891-8-50

Hamrick, I., & Counts, S. H. (2008). Vitamin and mineral supplements. *Primary Care: Clinics in Office Practice, 35*(4), 729-747. doi:10.1016/j.pop.2008.07.012

Heimer, K. A., Hart, A. M., Martin, L. G., & Rubio-Wallace, S. (2009). Examining the evidence for the use of vitamin C in the prophylaxis and treatment of the common cold. *Journal of the American Academy of Nurse Practitioners, 21*(5), 295–300. doi:10.1111/j.1745-7599.2009.00409.x

Hemilä, H., & Chalker, E. (2013). Vitamin C for preventing and treating the common cold. *Cochrane Database Systematic Reviews,* (3), CD000980. doi:10.1002/14651858.CD000980.pub4

Hemilä, H., & Louhiala, P. (2007). Vitamin C for preventing and treating pneumonia. *Cochrane Database Systematic Re*views, (1), CD005532. doi:10.1002/14651858.CD005532.pub2

Herbison, C. E., Hickling, S., Allen, K. L., O'Sullivan, T. A., Robinson, M., Bremner, A.P., …Oddy, W. H. (2012). Low intake of B-vitamins is associated with poor adolescent mental health and behavior. *Preventive Medicine, 55*(6), 634-638. doi:http://dx.doi.org/10.1016/j.ypmed.2012.09.014

Herrmann, W., & Obeid, R. (2008). Causes and early diagnosis of vitamin B12 deficiency*. Deutshches Arzteblatt International, 105*(40), 680-685. doi:10.3238/arztebl.2008.0680

Hoffman, D. J., Policastro, P., Quick, V, & Soo-Kyung, L. (2006). Changes in body weight and fat mass of men and women in the first year of college: A study of the "Freshman 15". *Journal of American College Health, 55*(1), 41-46. doi:10.3200/JACH.55.1.41-46

Hodge, C. N., Jackson, L. A., & Sullivan, L. A. (2003). The "Freshman 15" facts and fantasies about weight gain in college women. *Psychology of Women Quarterly, 17*(1), 119-126. doi:10.1111/j.1471-6402.1993.tb00680.x

Holick, M. F. (2010). The vitamin D deficiency pandemic: a forgotten hormone important for health. *Public Health Reviews, 32*, 267-283. Retrieved from http://www.publichealthreviews.eu/show/f/35

Holick, M. F. (2007). Vitamin D deficiency. *New England Journal of Medicine, 357,*266-281. Retrieved from http://www.grc.com/health/pdf/Vitamin_D_Deficiency_Medical_Progress.pdf

Holst-Schumacher, I., Monge-Rojas, R., & Barrantes-Santamaria, M. (2007). Prevalence of mild serum vitamin B12 deficiency in rural and urban Costa Rican young adults. *Pan American Journal of Public Health, 22*(6), 396-401. doi:10.1590/S1020-49892007001100005

Hooper, L., Ashton, K., Harvey, L. J., Decsi, T., & Fairweather-Tait, S. J. (2009). Assessing potential biomarkers of micronutrient status by using a systematic review methodology: methods. *American Journal of Clinical Nutrition, 89*(6), 1953S-1959S. doi:10.3945/ajcn.2009.27230A.

Howe, M., Leidel, A., Krishnan, S. M., Weber, A., Rubenfire, M., & Jackson, E. A. (2010). Patient-related diet and exercise couseling: Do providers' own lifestyle habits matter?, *Preventive Cardiology 13*(4), 180-185. doi:10.1111/j.1751-7141.2010.00079.x

Huang, Y. L. (1994). What do college students eat? Food selection and meal pattern. *Nutrition Research*, *14* (8), 1143-1153. doi:10.1016/S0271-5317(05)80242-8

Hvas, A. M., & Nexø, E. (2006). Diagnosis and treatment of vitamin B12 deficiency--An update. *Haematologica, 91*(11), 1506-1512. Retrieved from http://www.haematologica.org/content/91/11/1506.long

Hwang, C., Ross, V., & Mahadevan, U. (2012). Micronutrient deficiencies in inflammatory bowel disease: From A to zinc. *Inflammation Bowel Disease, 18*(10),1961-81. doi:10.1002/ibd.22906

Incecik, F., Hergüner, M. Ö., Altunbasak, S., & Leblebisatan, G. (2010). Neurologic findings of nutritional vitamin B12 deficiency in children. *The Turkish Journal of Pediatrics, 52*(1),17-21. Retrieved from http://www.turkishjournalpediatrics.org/pediatrics/pdf/pdf_TJP_727.pdf

Institute of Medicine. (2000). *Dietary reference intakes for calcium, magnesium, vitamin D, and fluoride.* Washington, D.C.: *Academy Press;* 190-249.

Instute of Medicine. (2004). *Improving medical education: Enhancing the behavioral and social science content of medical school curricula*. Washington, DC: National Academies Press. Retrieved from http://www.nap.edu/catalog.php?record_id=10956

Institute of Medicine. (2006). *Dietary Reference Intakes Research Synthesis: Workshop Summary*. Washington, DC: The National Academies Press. Retrieved from http://www.nap.edu/openbook.php?record_id=11767&page=61

Jackson, M. D., Walker, S. P., Younger, N. M., & Bennett, F.I. (2011). Use of a food frequency questionnaire to assess diets of Jamaican adults: validation and correlation with biomarkers. *Nutrition Journal,10*,28. doi:10.1186/1475-2891-10-28

Johnston, C. S., Martin, L. J., & Cai, X. (1992). Antihistamine effect of supplemental ascorbic acid and neutrophil chemotaxis. *Journal of American College of Nutrition, 11*(2), 172–176. Retrieved from http://www.ncbi.nlm.nih.gov/pubmed/1578094

Jones, A. N., & Hansen, K. E. (2009). Recognizing the musculoskeletal manifestations of vitamin D deficiency. *Journal Musculoskeletal Medicine, 26*(10), 389-396. Retrieved from http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3188408/pdf/nihms-266203.pdf

Junqueira, M., & Jaffe, F. (2012). Effects of shift-work regulaions on healthcare professionals. *American Osteopathic Association.*Retrieved from http://www.osteopathic.org/inside-aoa/news-and-publications/Documents/dd-21-26-junqueira-jaffe-march-2012.pdf

Kasparian, N. A. (2013). Psychological stress and melanoma: Are we meeting our patients'psychological needs? *Clinics in Dematology, 31*(1), 41-46. doi:10.1016/j.clindermatol.2011.11.005

Kaufman, S. F. M., & Palzer, S. (2011). Food structure engineering for nutrition, health and wellness. *Procedia Food Science, 1*, 1479-1486. doi:10.1016/j.profoo.2011.09.219

Kaput, J., & Rodriguez, R. L. (2004). Nutritional genomics: the next frontier in the postgenomic era. *Physiological Genomics, 16*(2), 166-177. doi:10.1152/physiolgenomics.00107.2003

Kelley, K., Clark, B., Brown, V., & Sitzia, J. (2003). Good practice in the conduct and reporting of survey research. *International Journal for Quality in Health Care, 15*(3), 261-266. doi:10.1093/intqhc/mzg031

Khokhar, O. S., & Lipman, T. O. (2012). Micronutrients. In Mullin, G. E.,Matarese, Jr. L. E. and Palmer, M. (Eds). *Gastrointestinal and liver disease nutrition desk reference* (pp. 265- 278). Boca Raton, Florida; CRC press.Kim, Y.I. (2004). Will mandatory folic acid fortification prevent or promote cancer?*American Journal Clinical Nutrition, 80*(5), 1123–1128. Retrieved from http://ajcn.nutrition.org/content/80/5/1123.full

Kim, Y. I .(2006). Does a high folate intake increase the risk of breast cancer? *Nutrition Reviews, 64*(10), 468–475. doi:10.1301/nr.2006.oct.468-475

Krajcovicová-Kudlácková, M., Blazícek, P., Kopcová, J., & Béderová, A. (2000). Homocysteine levels in vegetarians versus omnivores. *Annals of Nutrition & Metabolism, 44*, 135-138. doi:10.1159/000012827

Kushner, R. F., Kessler, S., & McGaghie, W. C. (2011). Using Behavior Change Plans to Improve Medical Student Self-Care. *Academic Medicine, 86(7)*, 901-906. doi:10.1097/ACM.0b013e31821da193

Kuzminski, A. M., Del Giacco, E. J., Allen, R. H., Stabler, S. P., & Lindenbaum, J. (1998). Effective Treatment of Cobalamin Deficiency With Oral Cobalamin. *Blood, 92*(4), 1191-1198. Retrieved from http://www.newmediaexplorer.org/chris/B12_Oral_in_Blood.pdf

Kwong, J. C., Carr, D., Dhalla, I. A., Tom-Kun, D., & Upshur, R. E. G. (2005). Oral vitamin B12 therapy in the primary care setting: a qualitative and quantitative study of patient perspectives. *BMC Family Practice, 6*,8. doi:10.1186/1471-2296/6/8

Lappe, J. M., Travers-Gustafson, D., Davies, K. M., Recker, R. R., & Heaney. (2007). Vitamin D and calcium supplementation reduces cancer risk: results of a randomized trial. *American Journal of Clinical Nutrition, 85,*1586-1591. Retrieved from http://ajcn.nutrition.org/content/85/6/1586.long

Levin, N. A., & Greer, K. E. (2000). Scurvy in an unrepentant carnivore. *Cutis, 66*(1), 39-44. Retrieved from http://www.ncbi.nlm.nih.gov/pubmed/10916690

Lesser, L. I., Cohen, D. A., & Brook, R. H. (2012). Changing eating habits for the medical profession. *Journal of the American Medical Association, 308(10)*, 983-984. doi:10.1001/2012.jama.10427

Lindeman, R. D., Romero, L. J., Koehler, K. M., Liang, H. C., LaRue, A., Baumgartner, R. N., &Garry, P. J. (2000). Serum vitamin B12, C and folate concentrations in the New Mexico elder health survey: Correlations with cognitive and affective functions. *Journal of the American College of Nutrition, 19*(1), 68-76. Retrieved from http://www.ncbi.nlm.nih.gov/sites/entrez?Db=pubmed&Cmd=Retrieve&list_uids=10682878&dopt=abstractplus

Linus Pauling Institute. (2011).Vitamin K. Oregon State University. Retrieved from http://lpi.oregonstate.edu/infocenter/vitamins/vitaminK/

Litonjua, A. A. (2009). Childhood asthma may be a consequence of vitamin D deficiency. *Current Opinion in Allergy and Clinical Immunology, 9*(3), 202-207. doi:10.1097/ACI.ob013e32832b36cd

Liu, T., Howard, R. M., Mancini, A. J., Weston, W. L., Paller, A. S., Drolet, B. A., … Frieden, I. J. (2001). Kwashiorkor in the United States: Fad diets perceived and true milk allergy, and nutritional ignorance. *Archives of Dermatology, 137*(5), 630-636. doi:10-1001/pubs.Arch Dermatol.-ISSN-0003-987x-137-5-dob0016

Lukaski, H. C. (2004). Vitamin and mineral status: Effects on physical performance. *Nutrition*, *20*(7/8), doi:10.1016/j.nut.2004.04.001

Ma, J., Hampl, J. S., & Betts, N. M. (2000). Antioxidant intakes and smoking status: data from the continuing survey of food intakes by individuals 1994-1996. *American Journal Clinical Nutrition, 71*(3), 774-780. Retrieved from http://www.ajcn.org/content/71/3/774.full.pdf

Mason, J. B., Lotfi, M., Dalmiya, N., Sethuraman, K., & Deitchler, M. (2001). The Micronutrient Report. Retrieved from http://www.tulane.edu/~internut/publications/MI%20REPORT.pdf

Mares-Perlman, J. A., Klein, B. E. K., Klein, R., Ritter, L. L., Freudenheim, J. L., & Luby, M. H. (1993). Nutrient supplements contribute to the dietary intake of middle- and older-aged adult residents of Beaver Dam, Wisconsin. *Journal of Nutrition, 123*(2), 176-188. Retrieved from http://jn.nutrition.org/content/123/2/176.long

Mensah, G., & Brown, D. (2007). An overview of crdiovascular disease burden in the United States. *HealthAffairs, 26(1)*, 38-48. doi:10.1377/hlthaff.26.138

McCormick, W. J. (1954). Intervertebral disc lesions: A new etiological concept. *Archives of Pediatrics, 71*(1), 29-32. Retrieved from http://www.ncbi.nlm.nih.gov/pubmed/13125754

McGrath, J. J., Burne, T. H., Feron, F., Mackay-Sim, A., &Eyles, D. W. (2010). Development vitamin D deficiency and risk of schizophrenia: a 10-year update. *Schizophrenia Bulletin, 36*(6), 1073-1078. doi:10.1093/schbul/sbq101

McGregor, G. P., & Biesalski, H. K. (2006). Rationale and impact of vitamin C in clinical nutrition. *Current Opinion in Clinical Nutrition and Metabolic Care*, 9(6), 697–703. doi:10.1097/01.mco.0000247478.79779.8f

McLean, E., Cogswell, M., Egli, I., Wojdyla, D., & de Benoist, B. (2009). Worldwide prevalence of anaemia, WHO vitamin and mineral nutrition information system, 1993–2005. *Public Health Nutrition*, *12*, 444–454. doi: 10.1017/S1368980008002401

Middlesman, A. B., Emans, J., & Cox, J. (1996). Nutritional vitamin B12 deficiency and folate deficiency in an adolescent patient presenting with anemia, weight loss, and poor school performance. *Journal of Adolescent Health, 19*,76-79. doi: 10.1016/1054-139X(95)00108-5

Mikolajczyk, R. T., Ansari, W. E., & Maxwell, A. E. (2009). Food comsumption frequency and perceived stress and depressive symptoms among students in three European countries. *Nutrition Journal, 8*,31. doi:10.1186/1475-2891-8-31

Misner, B. (2006). Food alone may not provide sufficient micronutrients for preventing deficiency. *Journal of the International Society of Sports Nutrition, 3*(1), 51-55. Retrieved from http://www.biomedcentral.com/content/pdf/1550-2783-3-1-51.pdf

Misra, M., Pacaud, D., Petryk, A., Collett-Solberg, P. F., & Kappy, M. (2008). Vitamin D deficiency in children and its management: Review of current knowledge and recommendations. *Pediatrics, 122,398-417.* doi:10.1542/peds.2007-1894

Moshfegn, A., Goldman, J., &Cleveland, L. (2005). What we eat in american, NHANES 2001-2002: Usual nutrient intakes from food compared to dietary reference intakes. *U.S. Department of Agriculture, Agricultural Research Service*. Retrieved from http://www.ars.usda.gov/SP2UserFiles/Place/12355000/pdf/0102/usualintaketables2001-02.pdf

Mota, M. C., De-Souza, D. A., Rossato, L.T., Silva, C. M., Araújo, M. B., Tufik, S., …Crispim, C. A. (2013) Dietary patterns, metabolic markers and subjective sleep measures in resident physicians, *Chronobiology International, 30*(8), 1032-1041. doi:10.3109/07420528.2013.796966

Muller, D. P. R. (2010). Vitamin E and neurological function. Review. *Molecular Nutrition & Food Research, 54*(5), 710–718. doi:10.1002/mnfr.200900460

Myint, P. K., Luben, R. N., Welch, A. A., Bingham, S. A., Wareham, N. J., Khaw, K.T. (2008). Plasma vitamin C concentrations predict risk of incident stroke over 10 y in 20 649 participants of the European prospective investigation into cancer Norfolk prospective population study. *American Journal Clinical Nutrition, 87* (1), 64–69. Retrieved from http://ajcn.nutrition.org/content/87/1/64.long

National Institutes of Health (NIH). (2012). Office of Dietary Supplements. Retrieved from http://ods.od.nih.gov/

National Institute of Mental Health (NIMH). (2011). Depressive Disorder Among Adults. Retrieved from http://www.nimh.nih.gov/statistics/1MDD_ADULT.shtml

Northrop-Clewes, C. A. & Thumham, D. I. (2007). Monitoring micronutrients in cigarette smokers. *Clinica Chimica Acta, 377*(1-2), 14-38. doi:10.1016/j.cca.2006.08.028

NutritionQuest. (2009). Assessment & Analysis Services. Retrieved from http://nutritionquest.com/assessment/tailored-tools-and-population-data-analysis/

Rice, B. H., Quann, E. E., and Miller, G. D. (2013). Meeting and exceeding dairy recommendations:effects of dairy consumption on nutrient ntakes and risk of chronic disease. *Nutrition Reviews, 71*(4), 209-223. doi:10.1111/nure.12007

Roger, V. L., Go, A. S., Loyd-Jones, D. M., Adams, R. J., Berry, J. D., Brown, T. M., …Wylie-Rosett, J. (2011). Heart disease and stroke statistics—2011 update: A report from the American Heart Association. *Circulation, 123*(4), e18-e209. doi:10.1161/CIR.0b013e3182009701

Rosen, C. J., Adams, J. S., Bikle, D. D., Black, D. M., Demay, M. B., Manson, J. E., … Kovacs, C. S. (2012). The nonskeletal effects of vitamin D: An Endocrine Soceity Scientific Statement. *Endocrine Reviews, 33*(3), 456-492. doi:10.1210/er.2012-1000

Trumbo, P., Schlicker, S., Yates, A. A., & Roos, M. (2002). Dietary reference intakes for energy, carbohydrate, fiber, fat, fatty acids, cholesterol, protein and amino acids. *Journal of the Academy of Nutrition and Dietetics, 102*(11), 1621-1630. doi:10.1016/S0002-8223(02)90346-9

Pearce, J. M. (2004). Thomas Addison (1793-1860). *Journal of the Royal Society of Medicine, 97(6)*, 297-300. Retrieved from http://www.ncbi.nlm.nih.gov/pmc/articles/PMC1079500/

Pilz, S., Tomaschitz, A., Drechsler, C., Dekker, J. M., & März, W. (2010). Vitamin D deficiency and myocardial diseases. *Molecular Nutrition Food Research, 54*,1103-1113. doi:10.1002/mnfr.200900474

Pucaj, K., Rasmussen, H., Moller, M., & Preston, T. (2011). Safety and toxicological evaluation of a synthetic vitamin K2, menaquinone-7. *Toxicology Mechanisms and Methods. 21*(7), 520-532. doi:10.3109/15376516.2011.568983

Qureshi, M. S., Shah, S. T., Ali, J., Khan, S. B., Hadi, A., Khan, A., ... & Hafizullah, M. (2012). Frequency of cardiovascular disease risk factors among doctors. *Pakistan Heart Journal*, *44*(3-4). Retrieved from
http://pkheartjournal.com/index.php/pkheart/article/view/17

Ramagopalan, S. V., Maugeri, N. J., Handunnetthi, L., Lincoln, M. R., Orton, S-M., Dyment, D. A., … & Knight, J. C. (2009). Expression of the multiple sclerosis-associated MHC class II allele HLA-DRB1*1501 is regulated by vitamin D. *PLoS Genetics*, doi: 10.1371/journal.pgen.1000369

Rao, C. R., Darshan, B. B., Das, N., Rajan, V., Bhogun, M., & Gupta, A. (2012). Practice of physical activity among future doctors: A cross sectional analysis. *International journal of preventive medicine*, *3*(5), 365. Retrieved from http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3372079/

Reiner, Ž., Sonicki, Z., & Tedeschi-Reiner, E. (2012). The perception and knowledge of cardiovascular risk factors among medical students. *Croatian medical journal*, *53*(3), 278-284. doi:10.3325/cmj.2012.53.278

Renwick, A. G., Flynn, A., Fletcher, R. J., Müller, D. J. G., Tuijtelaars, S., & Verhagen, H. (2004). Risk-benefit analysis of micronutrients. *Food and Chemical Toxicology,42*, 1903-1922. doi:10.1016/j.fct.2004.07.013

Ritchie, S. M., & Rigano, D. L. (2001) Researcher-participant positioning in classroom research. *International Journal of Qualitative Studies in Education, 14(6),* 741-756. doi:10.1080/09518390110078413

Ronzio, R. A. (2003). *The Encyclopedia of Nutrition and Good Health*. Second Edition. New York, N.Y. , Library of Congress Cataloging-In-Publication Data.

Roman-Vinas, B., Serra-Majem, L., Ribas-Barba, L., Ngo, J., Garica-Alvarez, A., Wijnhoven, T. M. A.,…& de Groot, L. C. P. G. M. (2009). Overview of methods to evaluate the adequacy of nutrient intakes for individuals and populations. *British Journal of Nutrition, 101*, suppl, 2, S6-S11. doi:10.1017/S0007114509990535

Rubeena, B., Anand, M., & Nadeem, A. (2012). Study of nutritional anemia in the medical students of Hind Institute of Medical Sciences, Barabanki. *Journal of Advance Researches In Biological Sciences. 4* (2), 101-103. Retrieved from http://www.scopemed.org/fulltextpdf.php?mno=30126

Sack, R. L., Auckley, D., Auger, R.R., Carskadon, M.A., Wright K.P., Vitiello, M.V., Zhdanova, I.V. (2007). Circadian Rhythm Sleep Disorders: Part I, Basic Principles, Shift Work and Jet Lag Disorders. *Sleep, 30*(11), 1460-1483.

Retrieved from http://www.ncbi.nlm.nih.gov/pmc/articles/PMC2082105/pdf/aasm.30.11.1460.pdf

Saladin, K.S. (2012). *Anatomy & physiology: The unity of form and function*, 6th edition. New York, NY: McGraw-Hill Education.

Sajwani, R. A., Shoukat, S., Raza, R., Shiekh, M. M., Rashid, Q., Siddique, M. S. ... & Kadir, M. M. (2009). Knowledge and practice of healthy lifestyle and dietary habits in medical and non-medical students of Karachi, Pakistan. *Journal of the Pakistan Medical Association*, *59*(9), 650. Retrieved from http://www.jpma.org.pk/full_article_text.php?article_id=1812

Sanjoaquin, M. A., Allen, N., Couto, E., Roddam, A. W., & Key, T. J. (2005). Folate intake and colorectal cancer risk: a meta-analytical approach. *International Journal of Cancer*, 113(5), 825–828. doi:10.1002/ijc.20648

Satia-Abouta, J., Patterson, R. E., King, I. B., Stratton, K. L., Shattuck, A. L., Kristal, A. R., …& White, E. (2003). Reliability and validity of self-report of vitamin and mineral supplement use in the vitamins and lifestyle study. *American Journal of Epidemiology, 157*(10), 94-954. doi:10.1093/aje/kwg039

Saunders, A. V., Craig, W. J., Baines, S. K., & Posen, J. S. (2012). Iron and vegetarian diets. *Medical Journal of Australia, Suppl 2*, 11-16. doi:10.5694/mjao11.11494

Schneider, C. (2005). "Chemistry and biology of vitamin E". *Molecular Nutrition & Food Research, 49*(1), 7–30. doi:10.1002/mnfr.200400049

Scholl, T. O., & Johnson, W. G. (2000). Folic acid: influence on the outcome of pregnancy. *American Journal of Clinical Nutrition, 71*(5 Suppl), 1295S-1303S. Retrieved from http://ajcn.nutrition.org/content/71/5/1295s.long

Schwenk, T. L., Gorenflo, D. W., & Leja, L. M. (2008). A survey on the impact of being depressed on the professional status and mental health care of physicians. *Journal of Clinical Psychiatry, 69*(4), 617-20. Retrieved from http://www.ncbi.nlm.nih.gov/pubmed/18426258

Seabolt, L., Spence, & Silver, H. J. (2012). Consistent prevalence of inadequate micronutrient intakes across six years of second-year medical school students. *Health, 4*(7), 357-365. doi:10.4236/health.2012.47058

Shearer, M. J., and Newman, P. (2008). Metabolism and cell biology of vitamin K. *Thrombosis and Haemostasis, 100*(4),530-547. doi:10.1160/TH08-03-0147

Sijbesma, F., & Sheeran, J. (2012). Micronutrients, Macro Impact: The story of vitamins and a hungry world. *Sight and Life. Retrieved from http://www.sightandlife.org/fileadmin/data/Books/Micronutrients_Macro_Impact.pdf*

Sira, N. & Pawlak, R. (2010) Prevalence of overweight and obesity, and dieting attitudes among Caucasian and African American college students in Eastern North Carolina: A cross-sectional survey . *Nutrition Research and Practice, 4*(1) p. 36-42. doi:10.4162/nrp.2010.4.1.36

Skinner, J. D. (1991). Changes in students' dietary behavior during a college nutrition course. *Journal of Nutrition Education, 23*(2) p. 72-75. doi:10.1016/S0022-3182(12)80007-0

Sriram, K., & Lonchyna, V. A. (2009). Micronutrient supplementation in adult nutrition therapy: practical considerations. *Journal of Parenteral and Enteral Nutrition, 33*, 548. doi:10.1177/0148607108328470.

StateUniversity.com. (2012). Keiser Universtiy. Retrieved from http://www.stateuniversity.com/universities/FL/Keiser_College.html

Streppel, M. T., de Vries, J. H. M., Meijboom, S., Beekma, M., de Craen, A. J. M., Slagboom, P. E., & Feskens, E. J. M. (2013). Relative validity of the food frequency questionnaire used to assess dietary intake in the Leiden Longevity study. *Nutrition Journal,12*, 75. doi:10.1186/1475-2891-12-75

Tanumihardjo, S. A. (2011). Vitamin A: biomarkers of nutrition for development. *American Journal of Clinical Nutrition, 94* (2), 658S-665S. doi:10.3945/ajcn.110.005777

Terwecoren, A., Steen, E., Benoit, D., Boon, P., & Hemelsoet, D.(2009). Ischemic stroke and hyperhomocysteinemia: truth or myth? *Acta Neurologica Belgica, 109* (3), 181–188. Retrieved from http://www.actaneurologica.be/acta/download/2009-3/03-Terwecoren%20et%20al.pdf

Tomat, A. L. (2011). Zinc restriction during different periods of life: Influence in renal and cardiovascular diseases. *Nutrition, 27(4),*392-398. doi:10.1016/j.nut.2010.09.010

Torheim, L. E., Ferguson, E. L., Penrose, K., & Arimond, M. (2010). Women in resource-poor settings are at risk of inadequate intakes of multiple micronutrients. *Journal of Nutrition,* 2051S-2058S. doi:10.3945/jn.110.123463

Trochim, W. M., & Donnelly, J. P. (2008). *The research methods knowledge base* (3rd ed.). Mason, OH: Atomic Dog.

Traber, M. G., & Stevens, J. F. (2011). Vitamin C and E: Beneficial effect from a mechanistic perspective. *Free Radical Biology and Medicine, 51*(5), 1000–1013. doi:10.1016/j.freeradbiomed.2011.05.017

Truong, J. T., & Booth, S. L. (2011). Emerging Issues in vitamin K research. *Journal of Evidence-Based Complementary & Alternative Medicine. 16*(1), 73-79. doi: 10.1177/1533210110392953

Tufan, A. E., Bilici, R., Usta, G., & Erdogan, A. (2012). Mood disorder with mixed, psychotic features due to vitamin B12 deficiecy in an adolescent: case report. *Adolescent Psychiatry and Mental Health, 6*,25. Retrieved from http://www.biomedcentral.com/content/pdf/1753-2000-6-25.pdf

Ulin, P. R., Robinson, E. T., & Tolley, E. E. (2005). *Qualitative methods in public health: A field guide for applied research*. San Francisco, CA: Jossey-Bass

U.S. Census Bureau. (2014). American FactFinder. 2008-2012 American community survey 5-year estimates. Retireved from http://quickfacts.census.gov/qfd/states/00000.html

U.S. Centers for Disease Control and Prevention. (2012). Second National Report on Biochemical Indicators of Diet and Nutrition in the U.S. Population 2012, Atlanta (GA): *National Center for Environmental Health*. Retrieved from http://www.cdc.gov/nutritionreport/

U.S. Census Bureau. Noss, A. (2012). Household Income for States: 2010 and 2011. *American Community Survey Briefs*. Retrieved from http://web.archive.org/web/20130120233359/http://www.census.gov/prod/2012pubs/acsbr11-

02.pdfhttp://web.archive.org/web/20121104095439/http://www.census.gov/hhes/www/income/index.html

U.S. Department of Agriculture. (2012). Food Security In the U.S. Retrieved from http://www.ers.usda.gov/topics/food-nutrition-assistance/food-security-in-the-us/key-statistics-graphics.aspx

U.S. Department of Agriculture and U.S. Department of Health and Human Services. (2010). Dietary Guidelines for Americans, 2010. 7th Edition, Washington, DC: Government Printing Office, December 2010. Retrieved from http://www.cnpp.usda.gov/dgas2010-policydocument.htm

U.S. Department of Labor. (2010). Statement by US Department of Labor's OSHA Assistant Secretary Dr. David Michaels on long work hours, fatigue and worker safety. Retrieved from

http://www.dol.gov/opa/media/press/osha/OSHA20101238.htm

USDA Center for Nutrition Policy and Promotion (2010). The report of the dietary guidelines advisory committee on the dietary guidelines for Americans 2010. Retrieved from http://www.cnpp.usda.gov/sites/default/files/dietary_guidelines_for_americans/2010DGACReport-camera-ready-Jan11-11.pdf

USDA National Agricultural Library (2012). Dietary Reference Intakes for Vitamin A, Vitamin K, Arsenic, Boron, Chromium, Cooper, Iodine, Iron, Manganese, Molybdenum, Nickel, Silicon, Vanadium, and Zinc (2001). *National Academy of Sciences. Institute of Medicine. Food and Nutrition Board.* Retrieved from http://fnic.nal.usda.gov/dietary-guidance/dri-reports/vitamin-vitamin-k-arsenic-boron-chromium-copper-iodine-iron-manganese#overlay-context=dietary-guidance/dri-reports/thiamin-riboflavin-niacin-vitamin-b6-folate-vitamin-b12-pantothenic

Van den Berg, V.L., Okeyo, A. P., Dannhauser, A., & Nel, M (2012). Body weight, eating practices and nutritional knowledge amongst university nursing students, Eastern, Cape, South Africa. *African Journal of Primary Health Care & Family Medicine, 4(1)*, 9 pages. doi:10.4102/phcfm.v4i1.323

Van Gelder, M. M. H. J., Bretveld, R. W., and Roeleveld (2010). Web-based Questionnaires: The Future in epidemiology? *American Journal of Epidemiology, 172*(11),1292-1298. doi:10.1093/aje/kwq291

Vermeer, C. (2012). Vitamin K: the effect on health beyond coagulation- an overview. *Food & Nutrition Research,* 56. doi:10.3402/fnr.v5610.5329

Vidal-Alaball, J., Butler, C., Cannings-John, R., Goringe, A., Hood, K., McCaddon, A., … & Papaioannou. A. (2005). Oral vitamin B12 versus intramuscular vitamin B12 for vitamin B12 deficiency (Review). *The Cochrane Collaboration*. doi:10.1002/14651858.CD004655.pub2

Villacorta, L., Graca-Souza, A. V., Ricciarelli, R., Zingg, J. M., & Azzi, A. (2003). α-Tocopherol induces expression of connective tissue growth factor and antagonizes tumor necrosis factor-α-mediated downregulation in human smooth muscle cells. *Circulation Research, 92*(1), 104–110. doi:10.1161/01.RES.0000049103.38175.1B

Vogel, T., Dali-Youcef, N., Kaltenbach, G., & Andres, E. (2009). Homocysteine, vitamin B12, folate and cognitive functions: a systematic and critical review of the literature. *International Journal of Clinical Practice, 63*(7), 1061-1067. doi:10.1111/j.1742-1241.2009.02026.x

Wannamethee, S. G., Lowe, G. D. Rumley, A., Bruckdofer, K. R., & Whincup, P. H. (2006). Associations of vitamin C status, fruit and vegetable intakes, and markers of inflammation and hemostasis. *American Journal of Clinical Nutrition, 83*(3), 567-574. Retrieved from http://www.ajcn.org/content/83/3/567.long

Watson, R. R., Zibadi, S., & Preedy, V. R., (2010). *Dietary Components and Immune Function*. Totowa, NJ: Humana Press.

Wells, K. B., Lewis, C. E., Leake, B., & Ware, J. E.Jr. (1984). Do physicians preach what they practice? A study of physicians' health habits and counseling practices. *Journal of the American Medical association, 252(20)*, 2846-2848. doi:10.1001/jama.1984.03350200032016

Whitney, E., Whitney, E. N., & Rolfes, S. R. (2011). *Understanding Nutrition* (Twelfth ed.). California: Wadsworth,Cengage Learning.

Wichianson, J. R., Bughi, S. A., Unger, J. B., Spruijt-Metz, D., & Nguyen-Rodriquez, S.T. (2009). Perceived stress, coping and night-eating in college students. *Stress and Health, 25*, 235-240. doi:10.1002/smi.1242

Wolf, G. (2001). The discovery of the visual function of vitamin A. *Journal of Nutrition, 131*(6), 1647–1650. Retrieved from http://jn.nutrition.org/content/131/6/1647.full

Woo, K. -S., Kim, K. -E., Park, J. -S., Park, J. -I., & Han, J. -Y. (2010). Relationship between the levels of holotranscobalamin and vitamin B12. *Korean Journal Laboratory Medicine, 30,* 185-189. doi:10.3343/kjlm.2010.30.2.185

World Health Organization. (2008). Worldwide prevalence of anemia 1993-2005. Retrieved from http://whqlibdoc.who.int/publications/2008/9789241596657_eng.pdf

World Health Organization. (2006). Guidelines on food fortification with micronutrients. Retrieved from http://whqlibdoc.who.int/publications/2006/9241594012_eng.pdf

World Health Organization. (2012). Nutrition. Micronutrient deficiencies- Iron deficiency anemia. Retrieved from http://www.who.int/nutrition/topics/ida/en/

World Health Organization. (2012). Vitamin and Mineral Nutrition Information System. Retrieved from http://www.who.int/vmnis/en/

World Health Organization. Prinzo, Z., & de Benoist, B. (2002). Meeting the challenges of micronutrient deficiencies in emergency-affected populations. *Proceedings of the Nutrition Society, 61*, 251-257. doi:10.1079/PNS2002151

Yancey, A. K., Sallis, R. E., & Bastani, R. (2013). Changing physical activity participation for the medical profession. *Journal of the American Medical Association, 309(2)*, 141-142. doi:10.1001/jama.2012.127989

Young, S. S., Eskenazi, B., Marchetti, F. M., Block, G., & Wyrobek, A. J. (2008). The association of folate, zinc and antioxidant intake with sperm aneuploidy in healthy non-smoking men. *Human Reproduction (Oxford, England), 23* (5), 1–9. doi:10.1093/humrep/den036

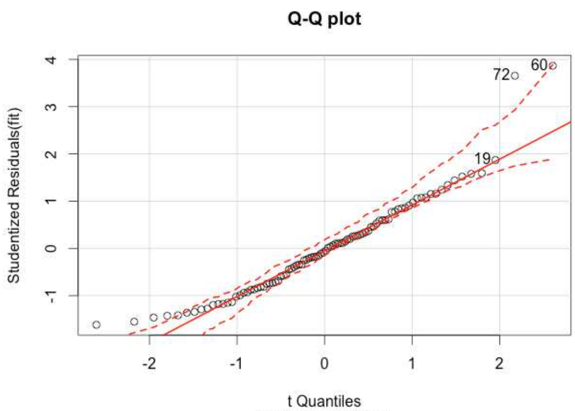
Yusuf, S., Hawken, S., Ôunpuu, S., Dans, T., Avezum, A., Lanas, F., ... & Lisheng, L. (2004). Effect of potentially modifiable risk factors associated with myocardial infarction in 52 countries (the INTERHEART study): Case-control study. *The Lancet*, *17,364*(9438), 937-952. doi:10.106/S0140-6736(04)17018-9

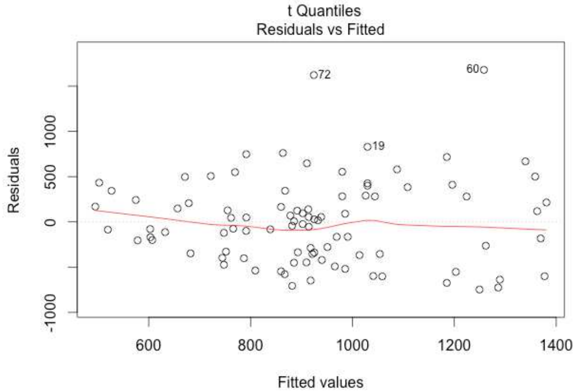
Zimmermann, M.B. (2009). Iodine Deficiency. *Endocrine Reviews, 30(4*),376-408. doi:10.210/er.2009-0011

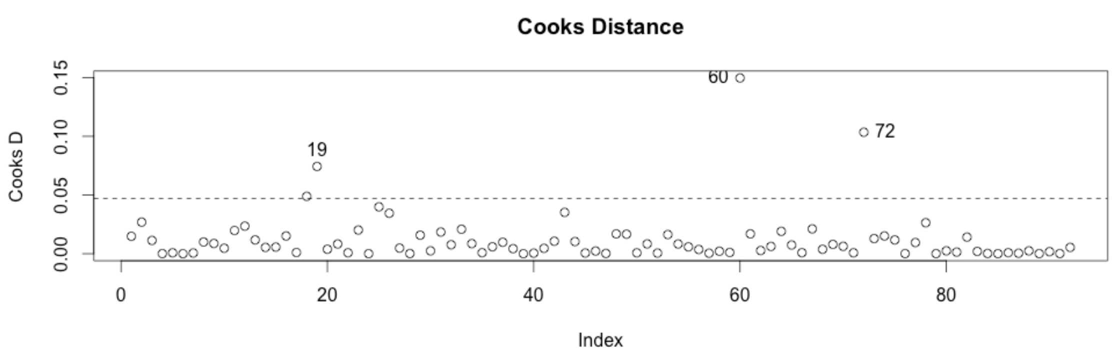
Appendix A: Regression Diagnosis

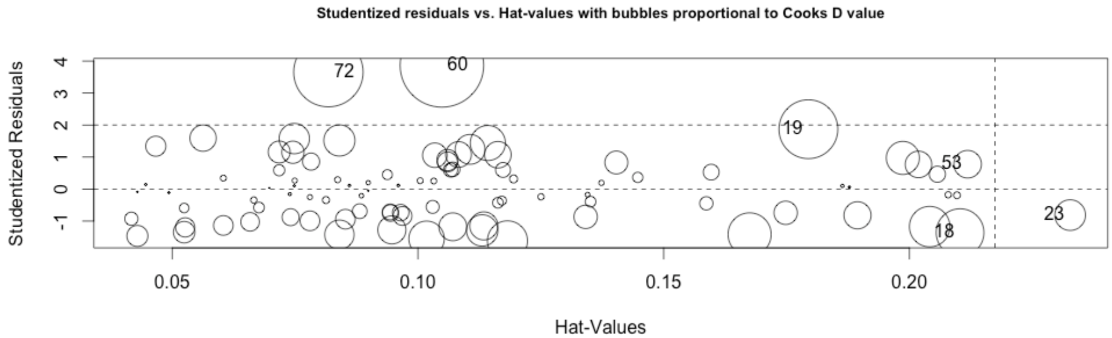
Regression diagnostics were performed for 14 multiple regression models each with specific micronutrient level as an outcome variable.

1. Calcium level as outcome:







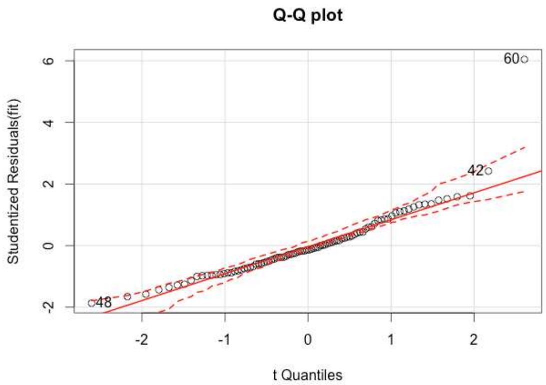


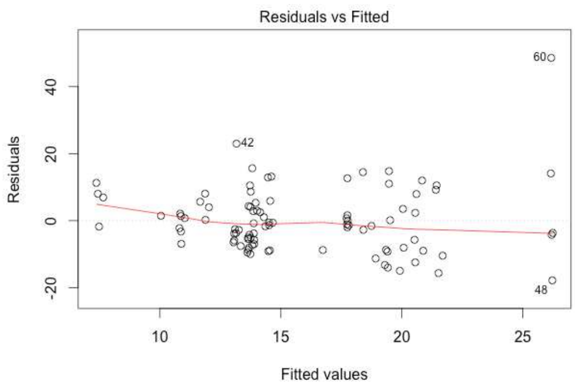
Above residuals vs. fit plot shows that residuals are randomly distributed around zero line suggesting assumption of linearity is reasonable. Residuals are roughly form a horizontal band around zero line which suggests residuals of error terms are equal. Residuals of observation 60 and 72 stand out from random pattern of residuals, so those are outliers.

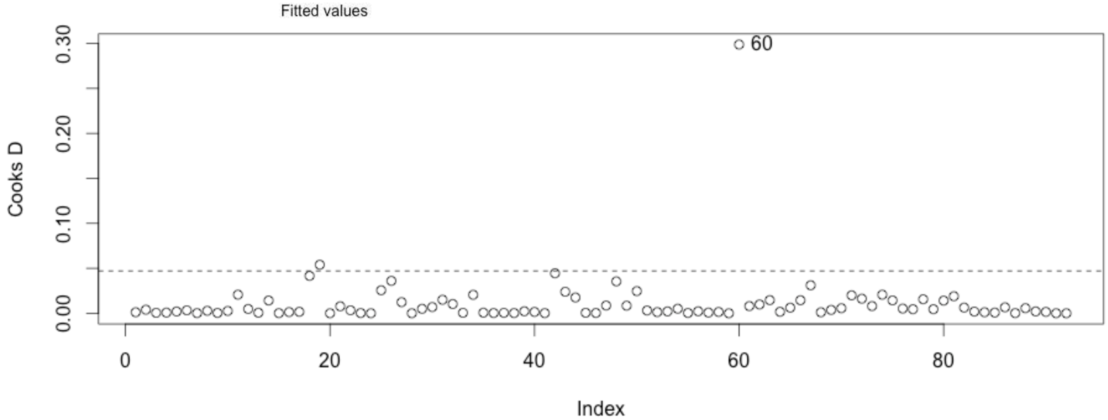
Q-Q plot shows that almost all the point except two fall on the straight line except two points (observation 60 and 42).

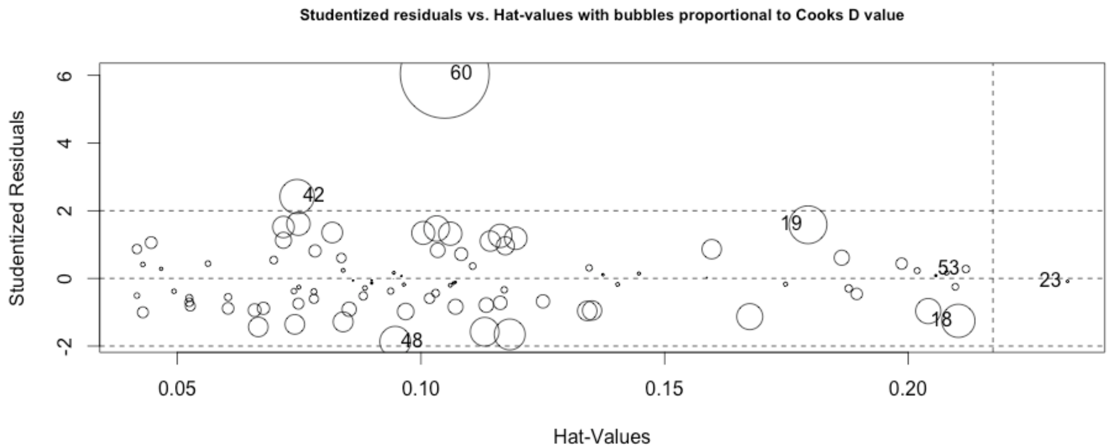
Plot with Cook's D shows that, observations 60, 72 and 17 had higher Cook's distance (using rule of thumb Cook's D > 4/(n-k-1)). Bubble plot shows that observation number 60 and 72 has higher studentized residual (greater than 2) along with larger Cook's D (larger size of circle) suggesting it is a influential point and model fit will be better excluding that observation from the analysis.

2. Iron level as outcome:





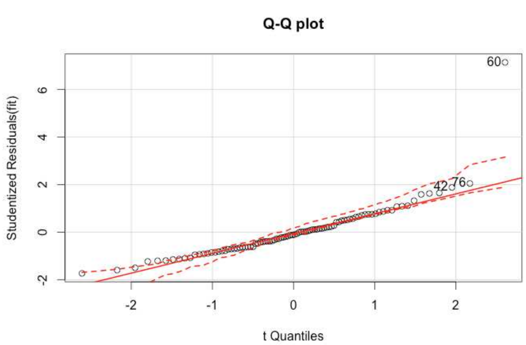


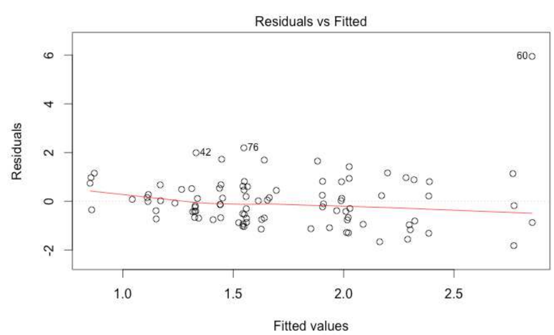


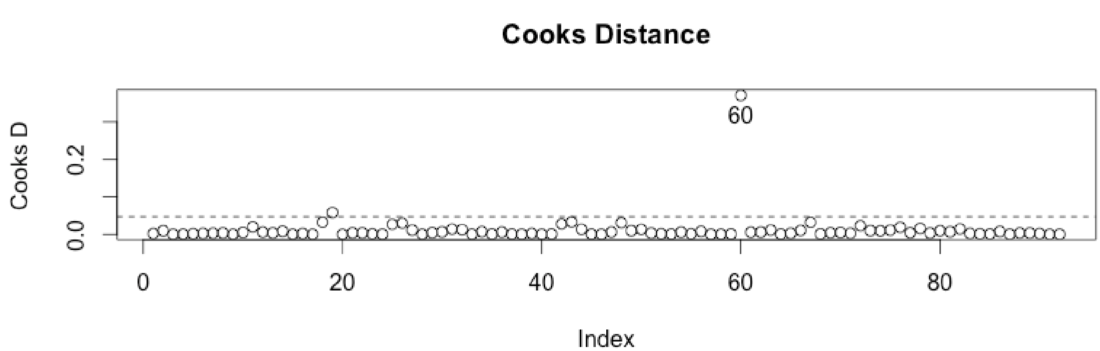
Q-Q plot shows that almost all the point fall on the straight line except two points (observation 60 and 42). Residual vs. fitted plot shows that residuals are clustered and has one outlier (observation 60)

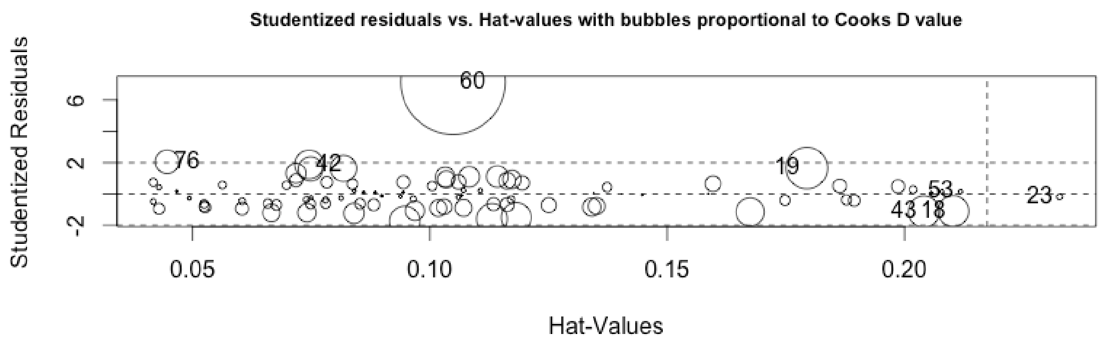
Plot with Cook's D shows that, observation 60 has higher Cook's distance (using rule of thumb Cook's D > 4/(n-k-1)). Bubble plot shows that observation number 60 has higher studentized residual (greater than 2) along with larger Cook's D (larger size of circle) suggesting it is a influential point and model fit will be better excluding that observation from the analysis.

3. Thiamine level as outcome:





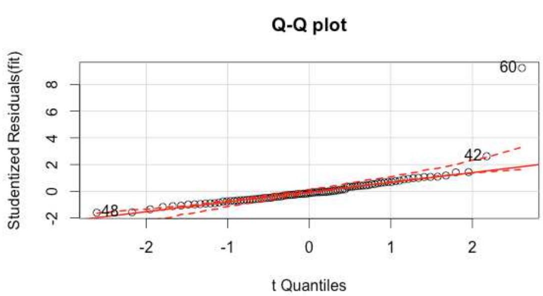


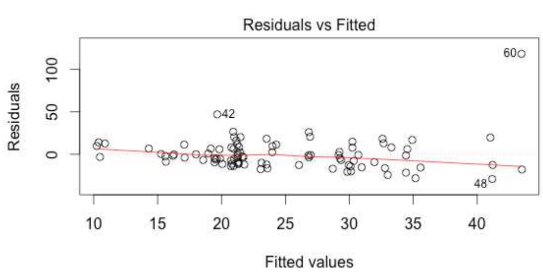


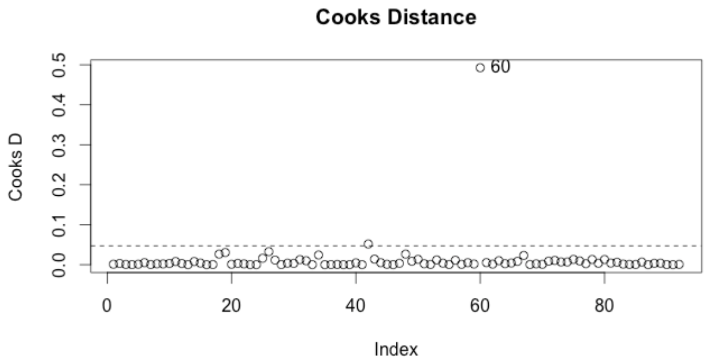
Q-Q plot shows that almost all the point fall on the straight line except observation 60. Residual vs. fitted plot shows that residuals are clustered and there is one outlier (observation 60)

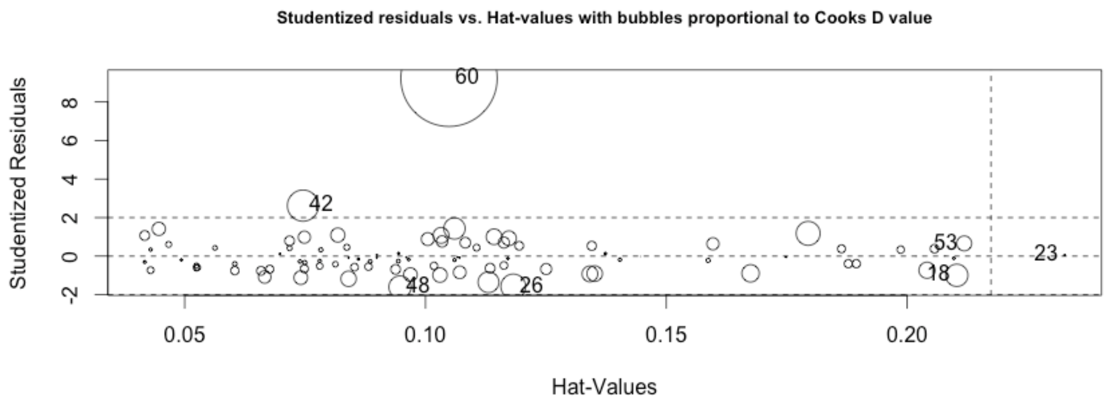
Plot with Cook's D shows that, observation 60 has higher Cook's distance (using rule of thumb Cook's D > 4/(n-k-1)). Bubble plot shows that observation number 60 has higher studentized residual (greater than 2) along with larger Cook's D (larger size of circle) suggesting it is a influential point and model fit will be better excluding that observation from the analysis.

4. Niacin as outcome level:





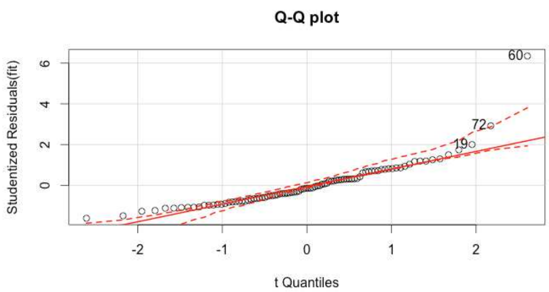


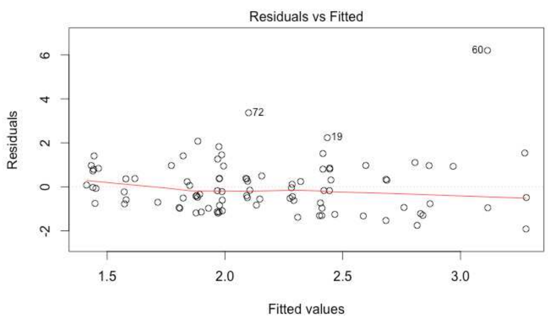


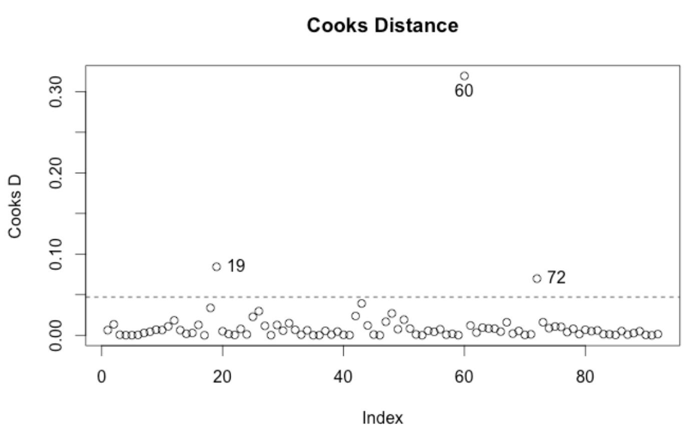
Q-Q plot shows that almost all the point fall on the straight line except observations 60 and 42. Residual vs. fitted plot (top right) shows that residuals are clustered and there is one outlier (observation 60)

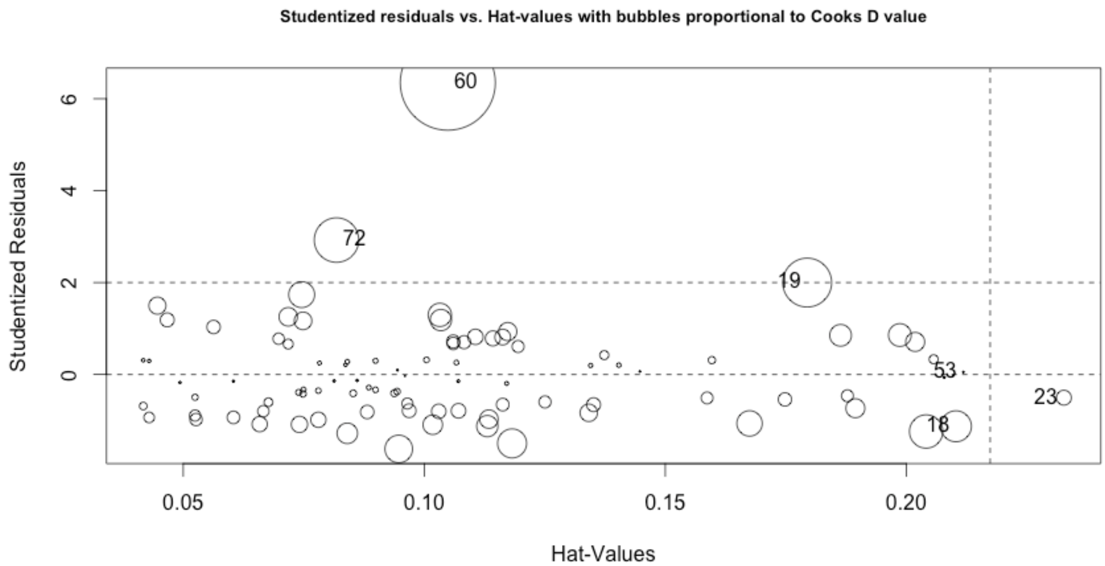
Plot with Cook's D shows that, observation 60 has higher Cook's distance (using rule of thumb Cook's D > 4/(n-k-1)). Bubble plot shows that observations 60 and 42 has higher studentized residual (greater than 2) along with larger Cook's D (larger size of circle) suggesting those are influential points and model fit will be better excluding these observations from the analysis.

5. Riboflavin level as outcome:





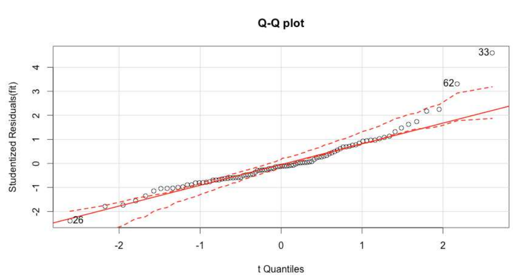


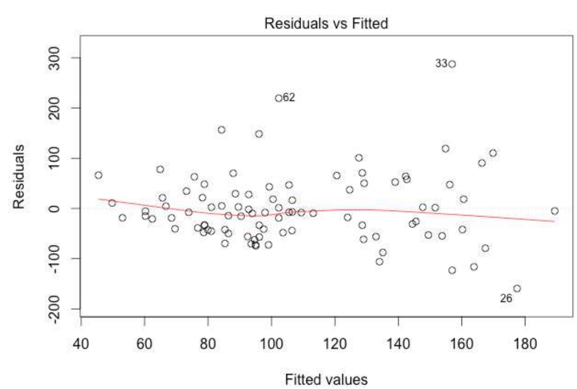


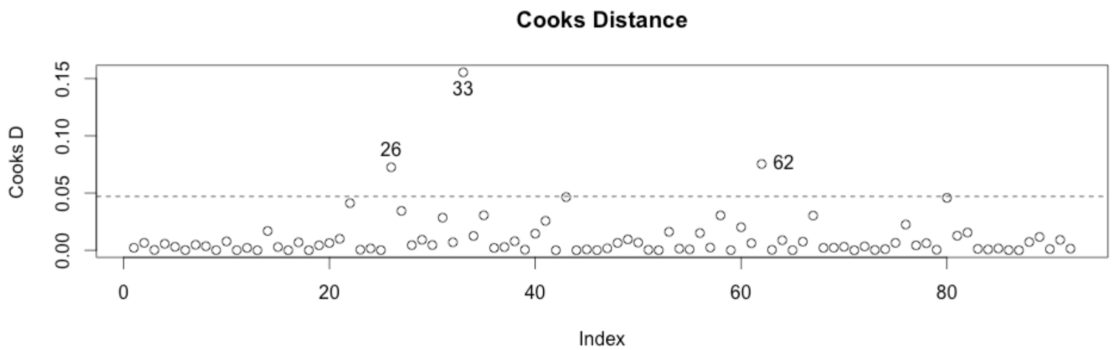
Q-Q plot shows that almost all the point fall on the straight line except observations 60 and 72. Residual vs. fitted plot also shows that observations 60 and 72 are outliers.

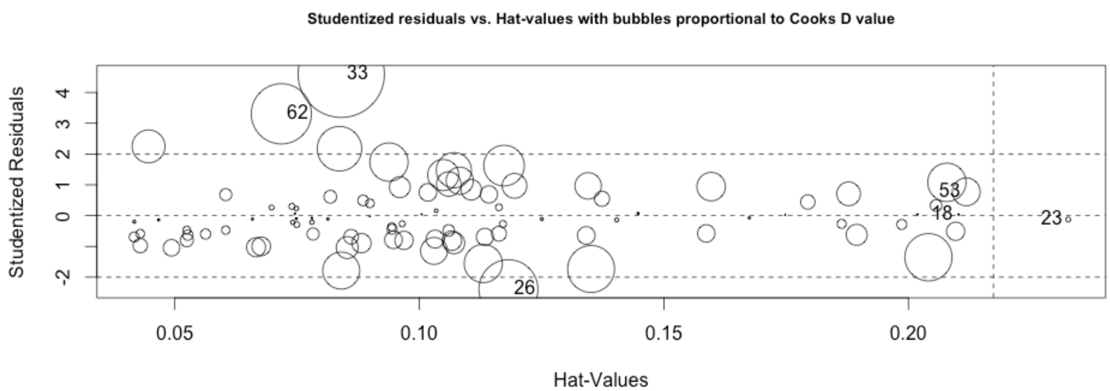
Plot with Cook's D shows that, observation 60, 19 and 72 has higher Cook's distance (using rule of thumb Cook's D > 4/(n-k-1)). Bubble plot shows that observation number 60 and 72 has higher studentized residual (greater than 2) along with larger Cook's D (larger size of circle) suggesting these two are influential points and model fit will be better excluding these observations from the analysis.

6. Vitamin C level as outcome:





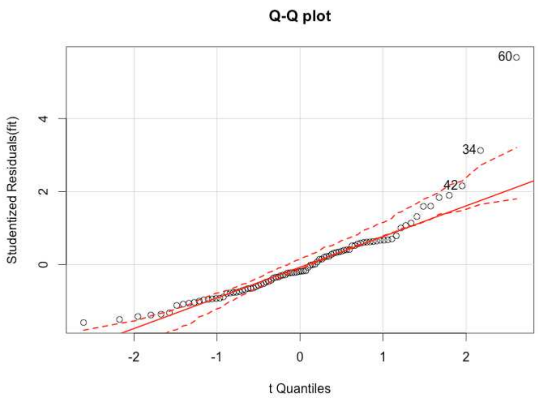


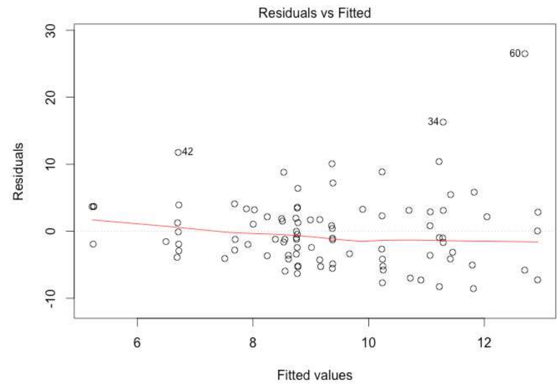


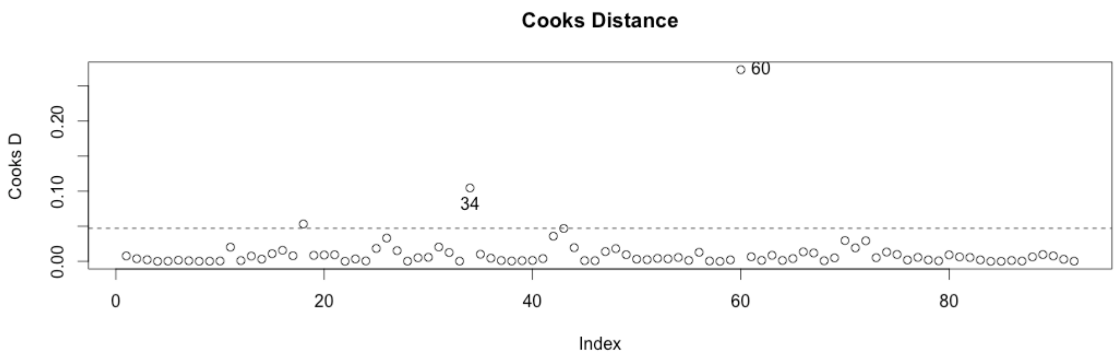
Q-Q plot shows that almost all the point fall on the straight line except observations 33 and 62. Residual vs. fitted plot also shows that observations 33 and 62 are outliers.

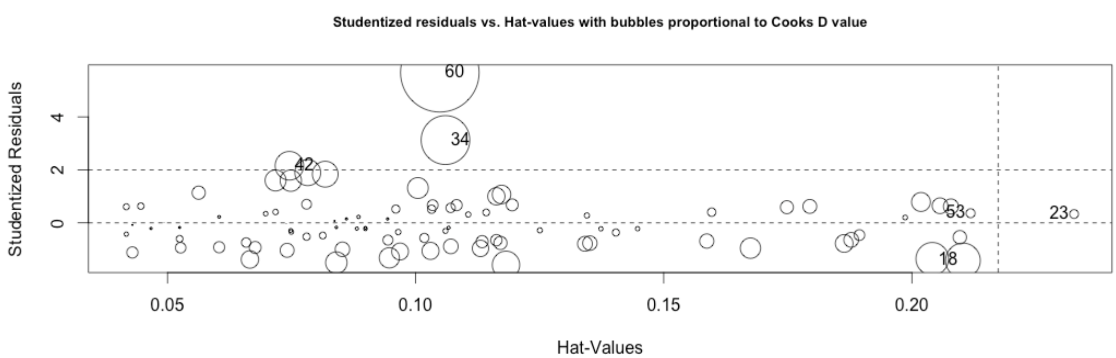
Plot with Cook's D shows that, observation 33, 62 and 26 has higher Cook's distance (using rule of thumb Cook's D > 4/(n-k-1)). Bubble plot shows that observation number 33 and 62 has higher studentized residual (greater than 2) along with larger Cook's D (larger size of circle) suggesting these two are influential points and model fit will be better excluding these observations from the analysis.

7. Vitamin ATOC (vitamin E) level as outcome:





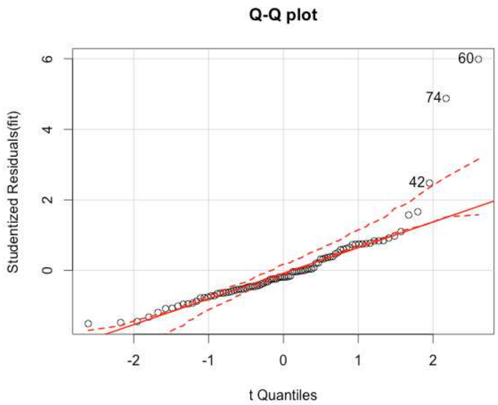


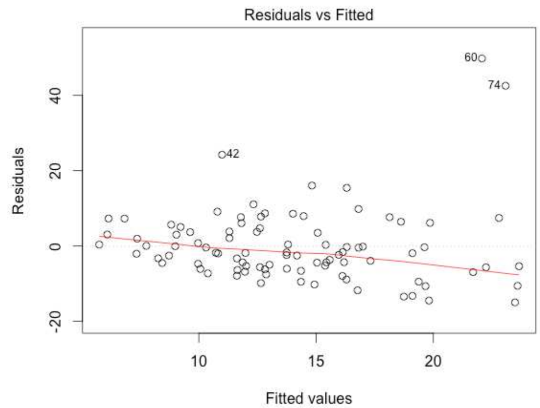


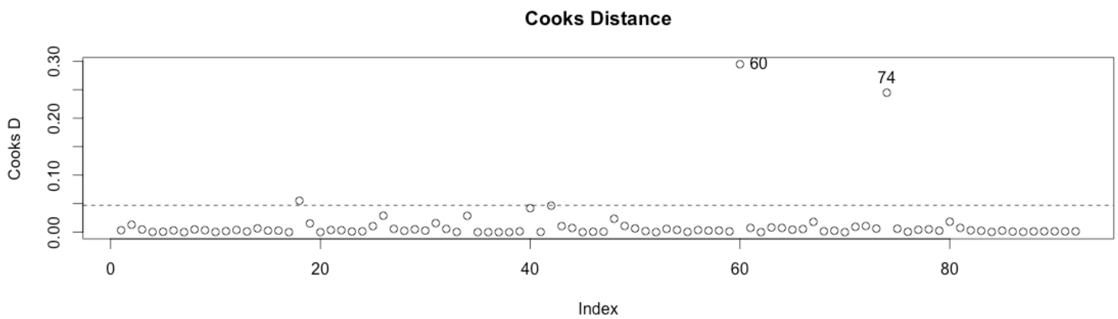
Q-Q plot shows that almost all the point fall on the straight line except observations 60, 34 and 42. Residual vs. fitted plot also shows that observations 60, 34 and 42 are outliers.

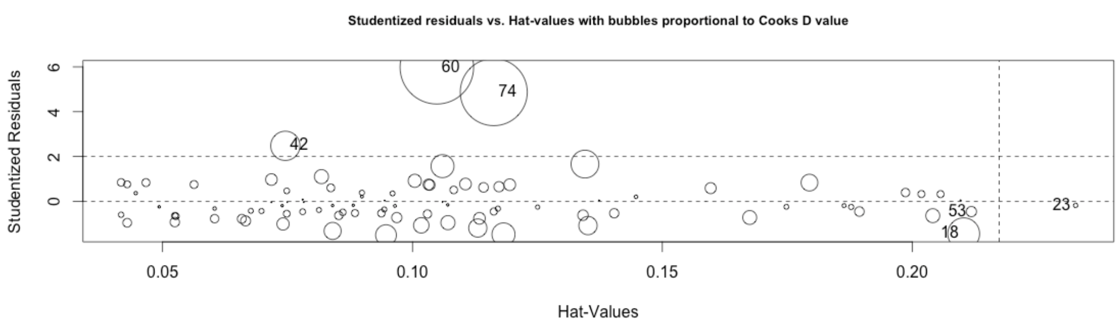
Plot with Cook's D shows that, observations 60, 34 had higher Cook's distance (using rule of thumb Cook's D > 4/(n-k-1)). Bubble plot shows that observations 60 and 34 had higher studentized residual (greater than 2) along with larger Cook's D (larger size of circle) suggesting these two are influential points and model fit will be better excluding these observations from the analysis.

8. Zinc level as outcome:





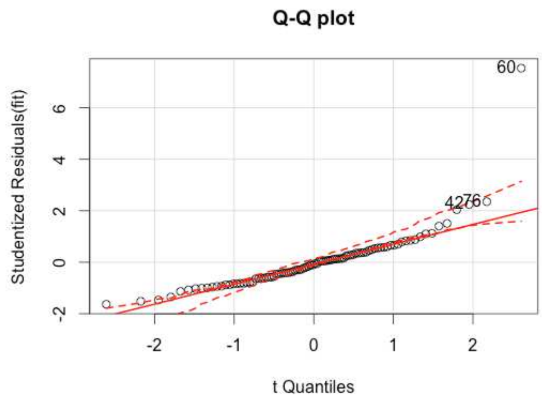


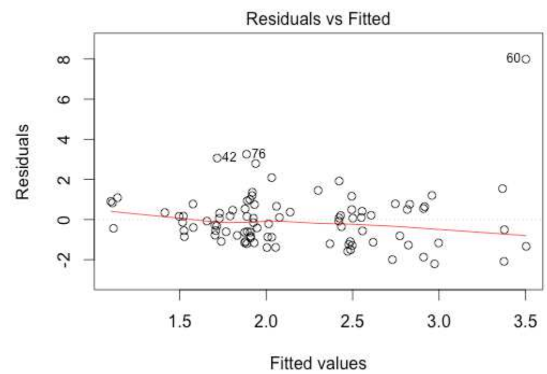


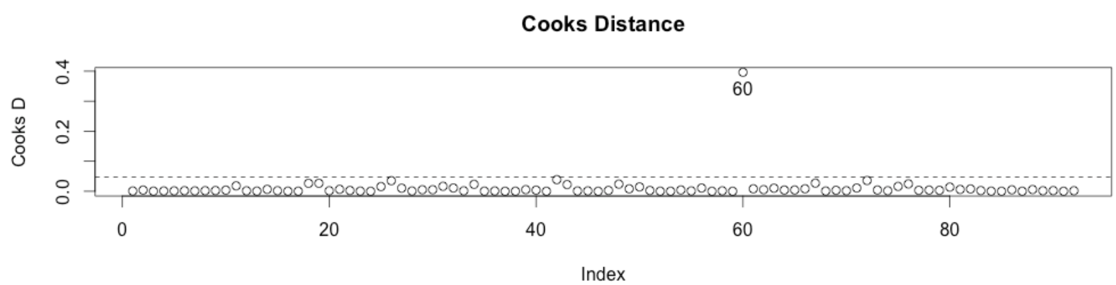
Q-Q plot shows that almost all the point fall on the straight line except observations 60, 74 and 42. Residual vs. fitted plot also shows that observations 60 and 74 are outliers.

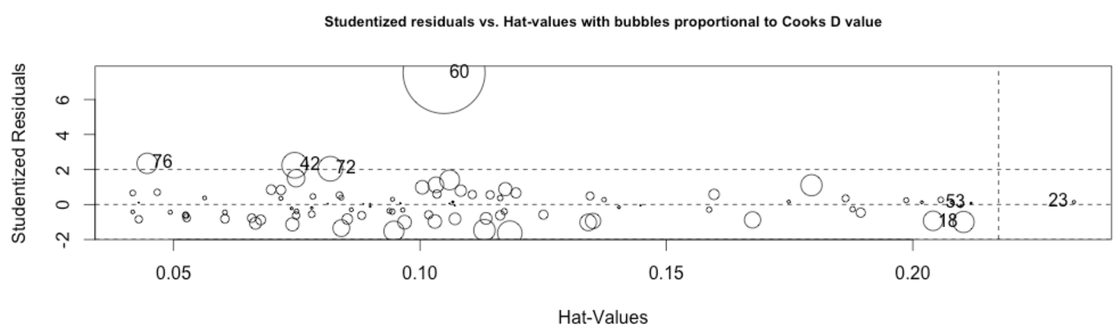
Plot with Cook's D shows that, observation 60 and 74 has higher Cook's distance (using rule of thumb Cook's D > 4/(n-k-1)). Bubble plot shows that observation number 60 and 74 has higher studentized residual (greater than 2) along with larger Cook's D (larger size of circle) suggesting these two are influential points and model fit will be better excluding these observations from the analysis.

9. Vitamin B6 level as outcome:





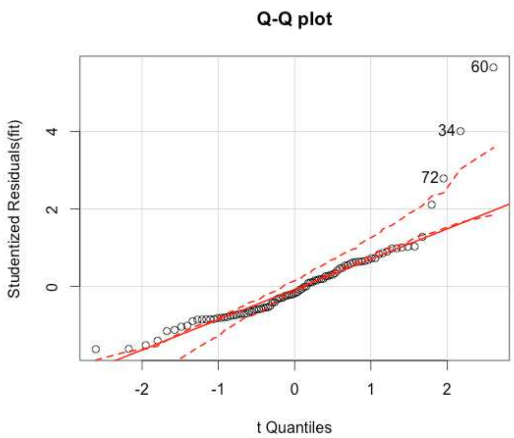


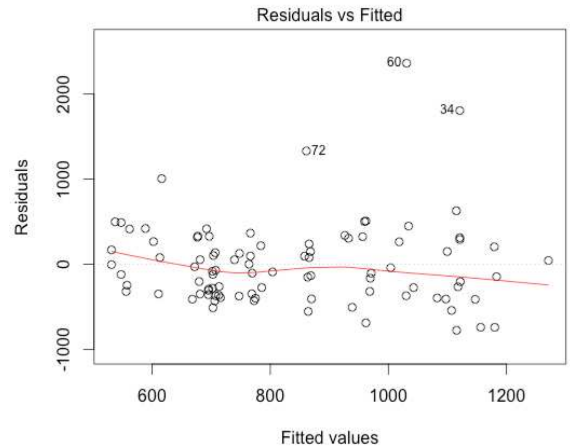


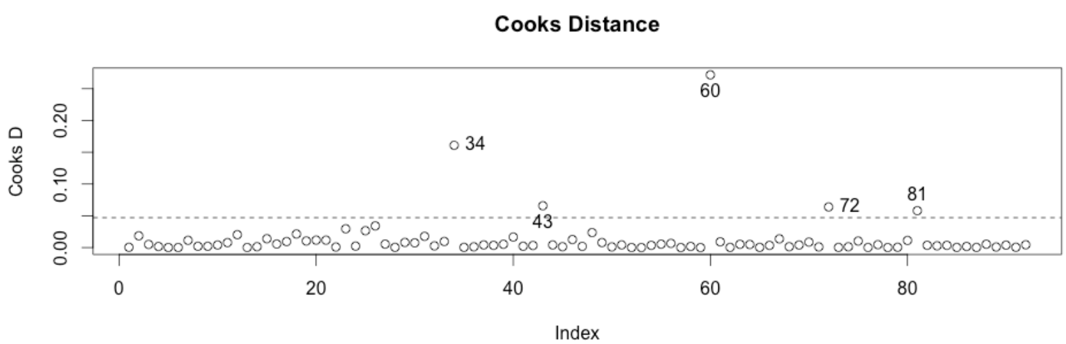
Q-Q plot shows that almost all the point fall on the straight line except observation 60. Residual vs. fitted plot also shows that observation 60 is an outlier.

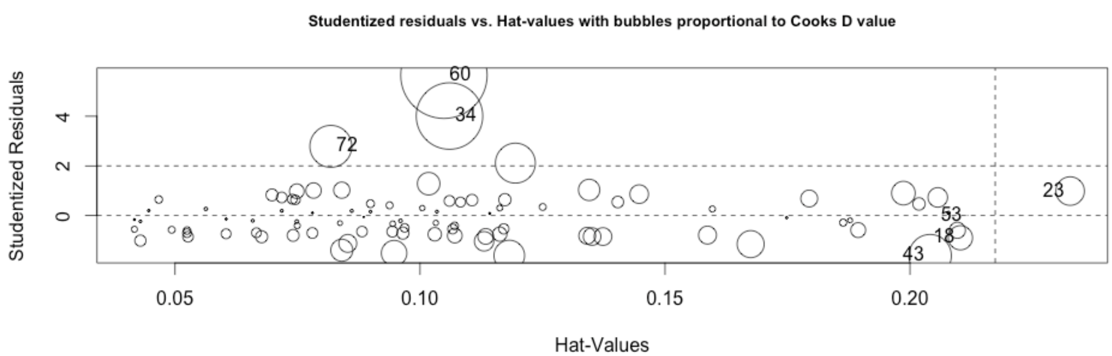
Plot with Cook's D shows that, observation 60 has higher Cook's distance (using rule of thumb Cook's D > 4/(n-k-1)). Bubble plot shows that observation number 60 has higher studentized residual (greater than 2) along with larger Cook's D (larger size of circle) suggesting these two are influential points and model fit will be better excluding these observations from the analysis.

10. Vitamin A level as outcome:





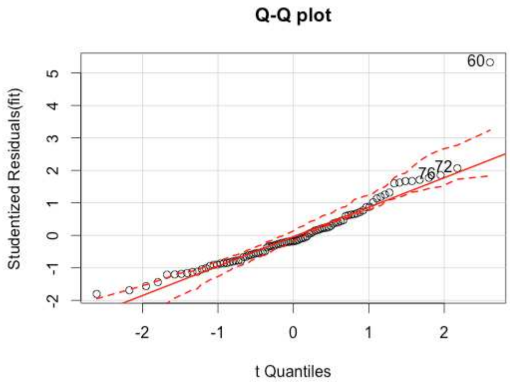


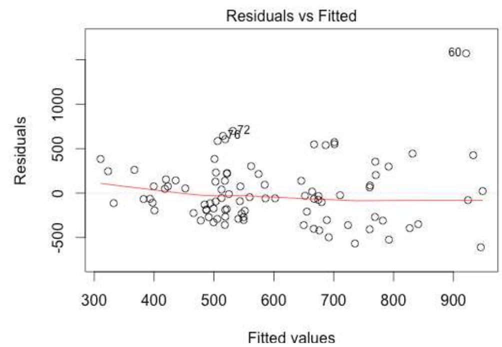


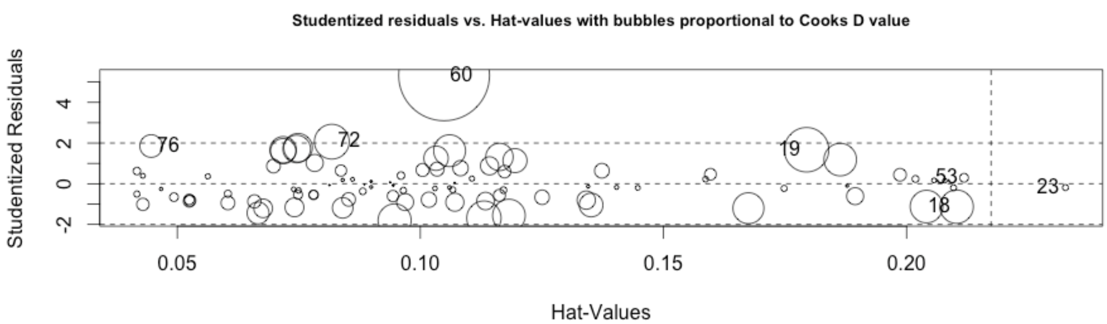
Q-Q plot shows that almost all the point fall on the straight line except observations 60, 34 and 72. Residual vs. fitted plot also shows that observations 60, 34 and 72 are outliers.

Plot with Cook's D shows that, observations 60, 34, 72 and 81 had higher Cook's distance (using rule of thumb Cook's D > 4/(n-k-1)). Bubble plot shows that observation numbers 60, 34 and 72 has higher studentized residual (greater than 2) along with larger Cook's D (larger size of circle) suggesting these two are influential points and model fit will be better excluding these observations from the analysis.

11. Folate level as outcome:



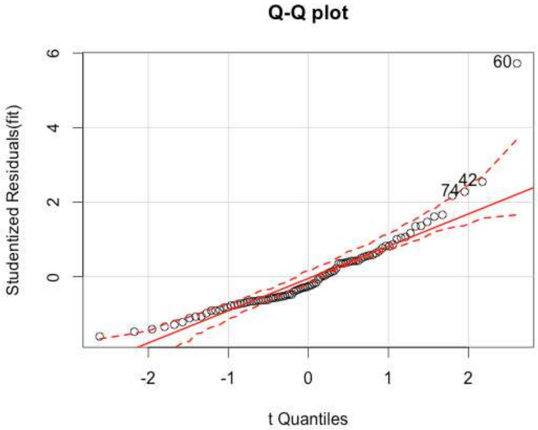


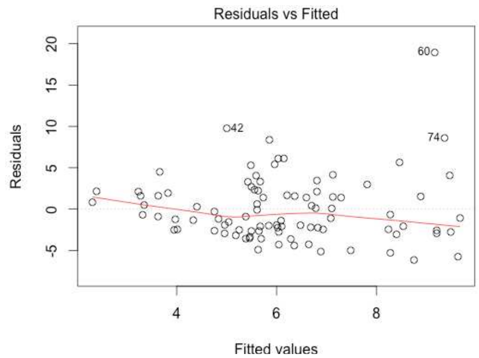


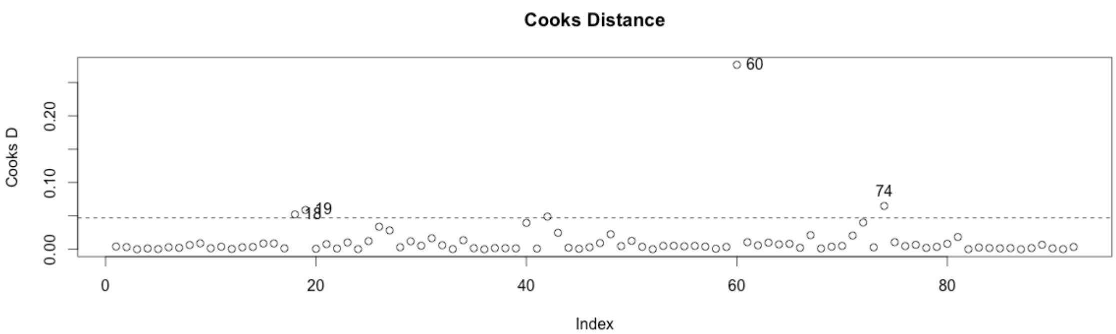
Q-Q plot shows that almost all the point fall on the straight line except observation 60. Residual vs. fitted plot also shows that observation 60 is an outlier.

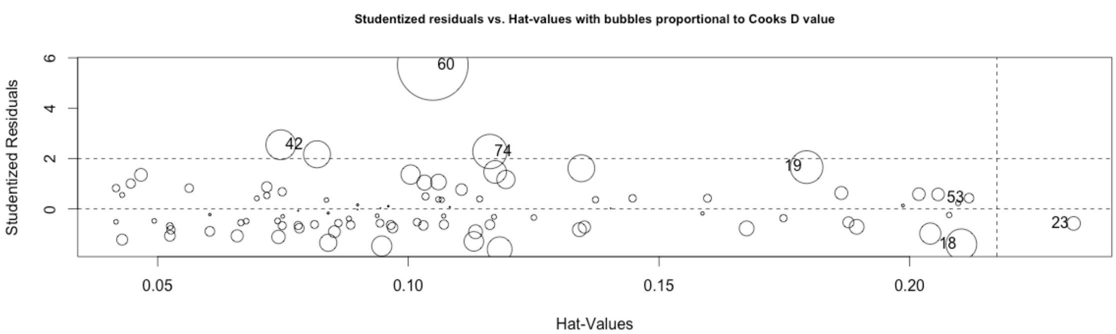
Plot with Cook's D shows that, observations 60 and 19 had higher Cook's distance (using rule of thumb Cook's D > 4/(n-k-1)). Bubble plot shows that observation 60 has higher studentized residual (greater than 2) along with larger Cook's D (larger size of circle) suggesting these two are influential points and model fit will be better excluding these observations from the analysis.

12. Vitamin B12 level as outcome:





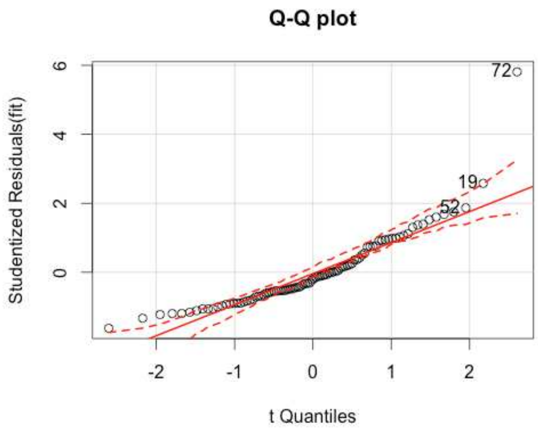


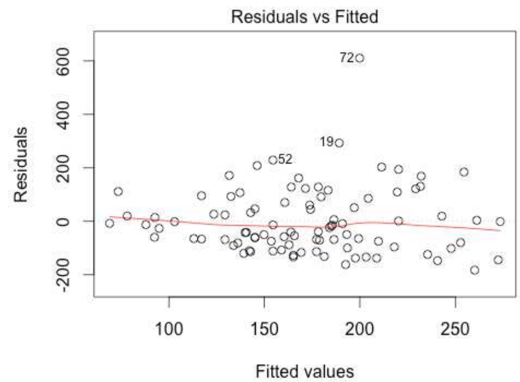


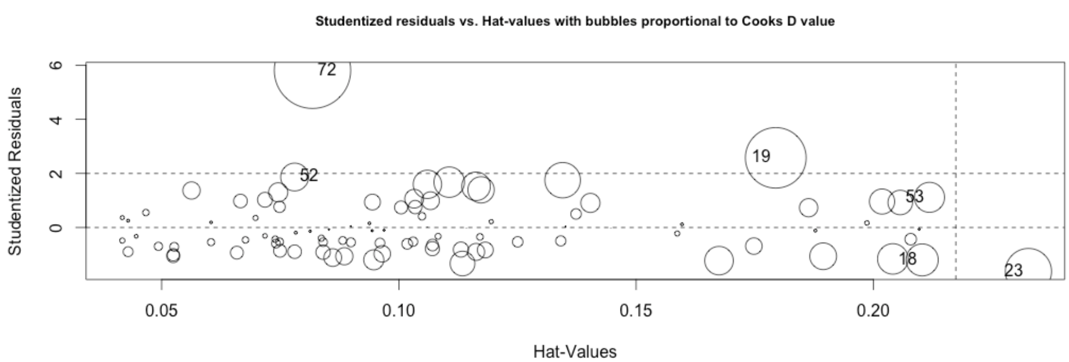
Q-Q plot shows that almost all the point fall on the straight line except observations 60, 42 and 72. Residual vs. fitted plot also shows that observation 60 and 42 are outliers.

Plot with Cook's D shows that, observations 60 and 74 had higher Cook's distance (using rule of thumb Cook's D > 4/(n-k-1)). Bubble plot shows that observation 60 has higher studentized residual (greater than 2) along with larger Cook's D (larger size of circle) suggesting these two are influential points and model fit will be better excluding these observations from the analysis.

13. Vitamin D level as outcome:



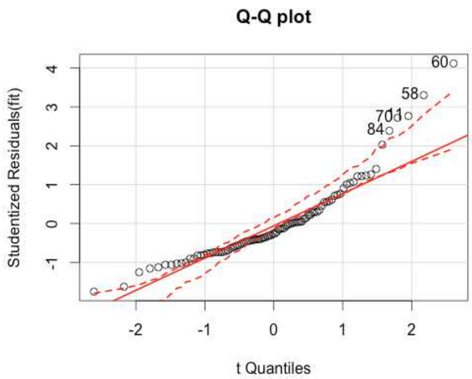


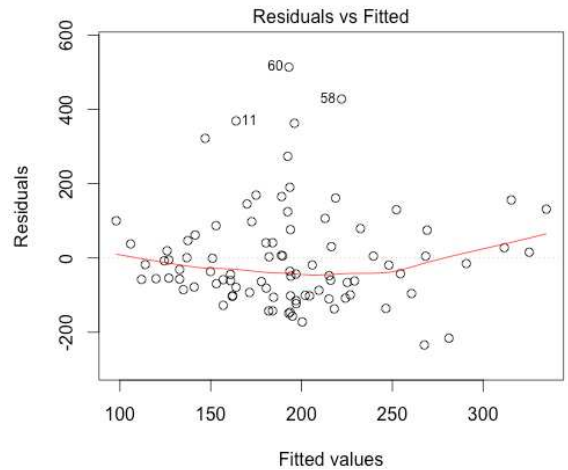


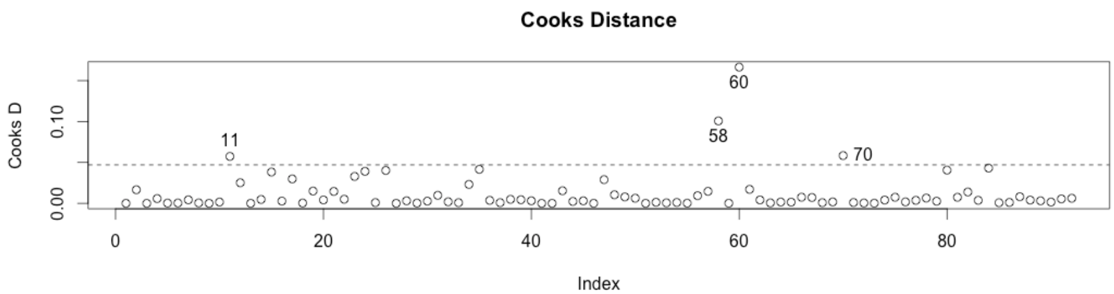
Q-Q plot shows that almost all the point fall on the straight line except observation 72. Residual vs. fitted plot also shows that observation 72 is an outlier.

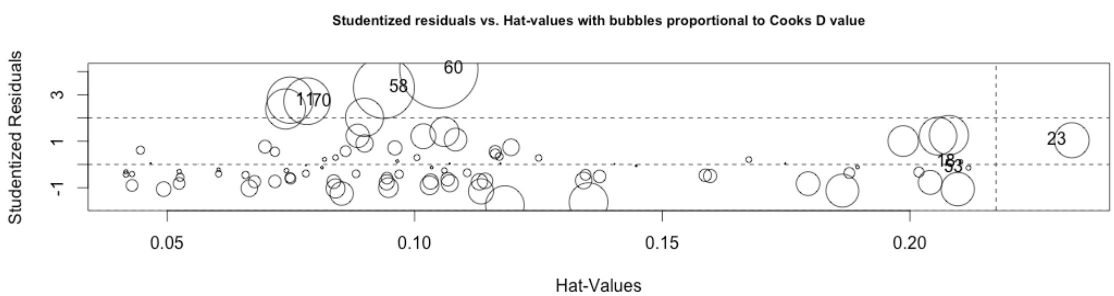
Plot with Cook's D shows that, observations 72, 19 and 23 had higher Cook's distance (using rule of thumb Cook's D > 4/(n-k-1)). Bubble plot shows that observation 72 has higher studentized residual (greater than 2) along with larger Cook's D (larger size of circle) suggesting these two are influential points and model fit will be better excluding these observations from the analysis.

14. Vitamin E level as outcome:









Q-Q plot shows that almost all the point fall on the straight line except observations 60, 58, 11, 70 and 84. Residual vs. fitted plot also shows that observations 60, 11 and 50 are outliers.

Plot with Cook's D shows that, observations 60, 58, 70 and 11 had higher Cook's distance (using rule of thumb Cook's D > 4/(n-k-1)). Bubble plot shows that observation 60, 58, 70 and 11 has higher studentized residual (greater than 2) along with larger Cook's D (larger size of circle) suggesting these two are influential points and model fit will be better excluding these observations from the analysis.

Appendix B: Fruit-Vegetable Screener and Self-Scored Sample

Fruit-Vegetable Screener©

Name :

Age:

Sex: ○ Male ○ Female

Think about your eating habits over the past year or so. About how often do you eat each of the following foods? Remember breakfast, lunch, dinner, snacks and eating out. Mark one bubble for each food.

Fruits and Vegetables	(0) Less than 1/WEEK	(1) Once a WEEK	(2) 2-3 times a WEEK	(3) 4-6 times a WEEK	(4) Once a DAY	(5) 2+ a DAY	**Score**
Fruit juice, like orange, apple, grape, fresh, frozen or canned. (Not sodas or other drinks)	○	○	○	○	○	○	____
How often do you eat any fruit, fresh or canned (not counting juice?)	○	○	○	○	○	○	____
Vegetable juice, like tomato juice, V-8, carrot	○	○	○	○	○	○	____
Green salad	○	○	○	○	○	○	____
Potatoes, any kind, including baked, mashed or french fried	○	○	○	○	○	○	____
Vegetable soup, or stew with vegetables	○	○	○	○	○	○	____
Any other vegetables, including string beans, peas, corn, broccoli or any other kind	○	○	○	○	○	○	____

Fruit Vegetable Score = ___

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Fruit-Vegetable Screener©

How well are you doing?

How to score your answers

- Mark one bubble for each food.
- At the top of each column is a number. At the right side of the page, beside each food, write the number that appears at the top of the column you marked (see the example below).

EXAMPLE

Meats and Snacks	(0) Less than 1/WEEK	(1) Once a WEEK	(2) 2-3 times a WEEK	(3) 4-6 times a WEEK	(4) Once a DAY	(5) 2+ a DAY	Score
Fruit juice, like orange, apple, grape, fresh, frozen or canned. (Not sodas or other drinks)	○	⊙	○	○	○	○	__1__
How often do you eat any fruit, fresh or canned (not counting juice?)	○	○	⊙	○	○	○	__2__

- Add up these numbers for all of your answers and refer to the scoring key below.

Scoring key:

If your score is:

0-10: You are not eating enough fruits and vegetables! You are probably eating fewer than 3 servings a day, but experts recommend 5 or more. You may be low in important vitamins, and fiber. Pick a few fruits or vegetables you like, and eat more of them. Green salad counts, too, and fruit juice or vegetable juice.

11-12: Your diet is like most Americans -- low in fruits and vegetables! You're eating fewer than 4 servings, but experts recommend 5 or more. Pick some you like, and eat them more often. Green salad counts, and fruit juice or vegetable juice.

13-15: You are doing better than most people, but you are still not eating 5 servings of fruits and vegetables every day. Try adding fruit or vegetable juice, or salad -- or just any fruit or vegetable you like.

16+: Congratulations! You're doing very well in fruits/vegetables, probably around 5 servings a day! Go for it!

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Appendix C: Block 2005 Food Frequency Questionnaire Sample

FOOD QUESTIONNAIRE

RESPONDENT ID #

0	0	0	0	0	0	0	0	0
1	1	1	1	1	1	1	1	1
2	2	2	2	2	2	2	2	2
3	3	3	3	3	3	3	3	3
4	4	4	4	4	4	4	4	4
5	5	5	5	5	5	5	5	5
6	6	6	6	6	6	6	6	6
7	7	7	7	7	7	7	7	7
8	8	8	8	8	8	8	8	8
9	9	9	9	9	9	9	9	9

TODAY'S DATE

Month	DAY		YEAR
Jan			
Feb			
Mar	0	0	2005
Apr	1	1	2006
May	2	2	2007
Jun	3	3	2008
Jul		4	2009
Aug		5	2010
Sep		6	2011
Oct		7	2012
Nov		8	2013
Dec		9	2014

ABOUT THIS SURVEY

This form is about the foods you usually eat.
It will take about 30 - 40 minutes to complete.
Please answer each question as best you can.
Estimate if you aren't sure.

- **USE ONLY A NO. 2 PENCIL.**
- **Fill in the circles completely, and erase completely if you make any changes.**

Please write your name in this box.

ABOUT YOU

SEX
- Male
- Female

If female, are you pregnant or breast feeding?
- No
- Yes
- Not female

AGE		WEIGHT pounds			HEIGHT ft.	in.
0	0	0	0	0		0
1	1	1	1	1		1
2	2	2	2	2		2
3	3	3	3	3	3	3
4	4	4	4	4	4	4
5	5	5	5	5	5	5
6	6	6	6	6	6	6
7	7		7	7		7
8	8		8	8		8
9	9		9	9		9
						10
						11

INSTRUCTIONS

There are usually two kinds of questions to answer for each food.

1. **HOW OFTEN,** on average, did you eat the food during the past year?
   *Please DO NOT SKIP any foods. Mark "Never" if you didn't eat any of the food in the question.
2. **HOW MUCH** did you usually eat of the food?
   *Sometimes we ask how <u>many</u> you eat, such as 1 egg, 2 eggs, etc., ON THE DAYS YOU EAT IT.
   *Sometimes we ask "how much" as A, B, C or D. **LOOK AT THE ENCLOSED PICTURES.**
   For each food, pick the picture (bowls or plates) that looks the most like the serving size you usually eat. (If you don't have pictures: A=1/4 cup, B=1/2 cup, C=1 cup, D= 2 cups.)
3. **EXAMPLE:** This person drank apple juice twice a week, and had one glass each time.
   Once a week he ate a "C"-sized serving of rice (about 1 cup).

	HOW OFTEN IN THE PAST YEAR: NEVER	A FEW TIMES per YEAR	ONCE per MONTH	2-3 TIMES per MONTH	ONCE per WEEK	2 TIMES per WEEK	3-4 TIMES per WEEK	5-6 TIMES per WEEK	EVERY DAY	HOW MUCH ON THOSE DAYS (SEE PORTION SIZE PICTURES FOR A-B-C-D)				
Apple juice	○	○	○	○	○	●	○	○	○	How many glasses each time	● 1	○ 2	○ 3	○ 4
Rice	○	○	○	○	●	○	○	○	○	How much each time	○ A	○ B	● C	○ D

PLEASE DO NOT WRITE IN THIS AREA

This section is about your usual eating habits in the past year or so. This includes all meals or snacks, at home or in a restaurant or carry-out. We will ask you about different TYPES (low-fat, low-carb) at the end of the survey. Include all types (like low-fat, sugar-free). Later you can tell us which type you usually eat.

	NEVER	A FEW TIMES per YEAR	ONCE per MONTH	2-3 TIMES per MONTH	ONCE per WEEK	2 TIMES per WEEK	3-4 TIMES per WEEK	5-6 TIMES per WEEK	EVERY DAY	HOW MUCH ON THOSE DAYS (SEE PORTION SIZE PICTURES FOR A-B-C-D)
Breakfast sandwiches with eggs, like Egg McMuffins										How many sandwiches in a day: 1, 2
Other eggs like scrambled, boiled or omelets (not egg substitutes)										How many eggs a day: 1, 2, 3
Breakfast sausage, including in sausage biscuits, or in breakfast sandwiches										How many pieces: 1, 2, 3
Bacon										How many pieces: 1, 2, 3, 4
Pancakes, waffles, French toast or Pop Tarts										How many pieces: 1, 2, 3
Cooked cereals like oatmeal, grits or cream of wheat										Which bowl: B, C, D
Cold cereals, ANY KIND, like corn flakes, fiber cereals, or sweetened cereals.										Which bowl: B, C, D
Milk or milk substitutes on cereal										
Yogurt or frozen yogurt										Which bowl: B, C
Cheese, sliced cheese or cheese spread, including on sandwiches										How many slices: 1, 2, 3

How often do you eat the following foods all year round? Estimate your average for the whole year.

	NEVER	A FEW TIMES per YEAR	ONCE per MONTH	2-3 TIMES per MONTH	ONCE per WEEK	2 TIMES per WEEK	3-4 TIMES per WEEK	5-6 TIMES per WEEK	EVERY DAY	HOW MUCH ON THOSE DAYS
Bananas										How many each time: 1/2, 1
Apples or pears										How many each time: 1/2, 1, 2
Oranges or tangerines										How many each time: 1/2, 1, 2
Grapefruit										How much: A little, 1/2, 1
Peaches or nectarines, fresh										How many: 1/2, 1, 2
Other fresh fruits like grapes, plums, honeydew, mango										How much: A, B, C
Canned fruit like applesauce, fruit cocktail, canned peaches or canned pineapple										How much: A, B, C

How often do you eat each of the following 3 fruits, just during the summer months when they are in season?

	NEVER	A FEW TIMES per YEAR	ONCE per MONTH	2-3 TIMES per MONTH	ONCE per WEEK	2 TIMES per WEEK	3-4 TIMES per WEEK	5-6 TIMES per WEEK	EVERY DAY	HOW MUCH ON THOSE DAYS
Cantaloupe, in season										How much: 1/8, 1/4, 1/2
Strawberries or other berries, in season										How much: A, B, C
Watermelon, in season										How much: A, B, C, D

How often do you eat each of the following vegetables all year round, including fresh, frozen, canned or in stir-fry, at home or in a restaurant?

	NEVER	A FEW TIMES per YEAR	ONCE per MONTH	2-3 TIMES per MONTH	ONCE per WEEK	2 TIMES per WEEK	3-4 TIMES per WEEK	5-6 TIMES per WEEK	EVERY DAY	HOW MUCH ON THOSE DAYS
Broccoli										How much: A, B, C
Carrots, or mixed vegetables with carrots										How much: A, B, C
Corn										How much: A, B, C

	NEVER	A FEW TIMES per YEAR	ONCE per MONTH	2-3 TIMES per MONTH	ONCE per WEEK	2 TIMES per WEEK	3-4 TIMES per WEEK	5-6 TIMES per WEEK	EVERY DAY	HOW MUCH ON THOSE DAYS (SEE PORTION SIZE PICTURES FOR A-B-C-D)
Green beans or green peas										How much: A B C
Spinach (cooked)										How much: A B C
Greens like collards, turnip greens, mustard greens										How much: A B C
Sweet potatoes, yams										How much: A B C
French fries, home fries, hash browns										How much: A B C D
Potatoes not fried, including mashed, boiled, baked, or potato salad										How much: A B C D
Cole slaw, cabbage, Chinese cabbage										How much: A B C
Green salad, lettuce salad										How much: B C D
Raw tomatoes										How much: 1/4 1/2 1
Salad dressing, any kind, regular or low-fat										How many tablespoons: 1 2 3 4
Any other vegetable, like squash, cauliflower, okra, cooked peppers										How much: A B C D
Refried beans or bean burritos										How much of the beans: A B C
Pinto beans, black beans, chili with beans, baked beans										How much: A B C D
Vegetable stew (without meat)										Which bowl: B C D
Vegetable soup, vegetable-beef soup, or tomato soup										Which bowl: B C D
Split pea, bean or lentil soup										Which bowl: B C D
Any other soup including chicken noodle, cream soups, Cup-A-Soup, ramen										Which bowl: B C D
Pizza										How many slices: 1 2 3 4
Spaghetti, lasagna or other pasta with tomato sauce										How much: B C D
Macaroni and cheese										How much: B C D
Other noodles like egg noodles, pasta salad, sopa seca										How much: B C D
Tofu or tempeh										How much: A B C
Meat substitutes like veggie burgers, veggie chicken, vegetarian hot dogs or vegetarian lunch meats										How many patties or dogs: 1 2
Do you ever eat chicken, meat or fish? ◯ Yes ◯ No IF NO, SKIP TO BREADS ON NEXT PAGE										
Hamburgers, cheeseburgers, at home or in a restaurant										How much: 1 sm 1 lrg 2
Hot dogs, or sausage like Polish, Italian or chorizo										How many hotdogs: 1 2 3

PLEASE DO NOT WRITE IN THIS AREA

	NEVER	A FEW TIMES per YEAR	ONCE per MONTH	2-3 TIMES per MONTH	ONCE per WEEK	2 TIMES per WEEK	3-4 TIMES per WEEK	5-6 TIMES per WEEK	EVERY DAY	HOW MUCH ON THOSE DAYS SEE PORTION SIZE PICTURES FOR A-B-C-D	
Lunch meat like bologna, sliced ham, turkey bologna, or any other lunch meat	○	○	○	○	○	○	○	○	○	How many **slices**	○ 1 ○ 2 ○ 3 ○ 4
Meat loaf, meat balls	○	○	○	○	○	○	○	○	○	How **much**	○ B ○ C ○ D
Steak, roast beef, or beef in frozen dinners or sandwiches	○	○	○	○	○	○	○	○	○	How **much**	○ A ○ B ○ C ○ D
Tacos, burritos, enchiladas, tamales, with meat or chicken	○	○	○	○	○	○	○	○	○	How **much**	○ A ○ B ○ C ○ D
Ribs, spareribs	○	○	○	○	○	○	○	○	○	How **much**	○ A ○ B ○ C ○ D
Pork chops, pork roasts, cooked ham (including for breakfast)	○	○	○	○	○	○	○	○	○	How **much**	○ A ○ B ○ C ○ D
Veal, lamb, deer meat	○	○	○	○	○	○	○	○	○	How **much**	○ A ○ B ○ C
Liver, including chicken livers or liverwurst	○	○	○	○	○	○	○	○	○	How **much**	○ A ○ B ○ C
Pigs feet, neck bones, oxtails, tongue	○	○	○	○	○	○	○	○	○	How **much**	○ A ○ B ○ C
Menudo, pozole, caldo de res, sancocho, ajiaco	○	○	○	○	○	○	○	○	○	Which **bowl**	○ B ○ C ○ D
Any other beef or pork dish, like beef stew, beef pot pie, corned beef hash, Hamburger Helper	○	○	○	○	○	○	○	○	○	How **much**	○ B ○ C ○ D
Fried chicken, including chicken nuggets, wings, chicken patty	○	○	○	○	○	○	○	○	○	How many **medium pieces**	○ 1 ○ 2 pcs/ nugts ○ 3
Roasted or broiled chicken or turkey	○	○	○	○	○	○	○	○	○	How **much**	○ A ○ B ○ C
Any other chicken dish, like chicken stew, chicken with noodles, chicken salad, Chinese chicken dishes	○	○	○	○	○	○	○	○	○	How **much**	○ B ○ C ○ D
Oysters	○	○	○	○	○	○	○	○	○	How **much**	○ A ○ B ○ C
Shellfish like shrimp, scallops, crabs	○	○	○	○	○	○	○	○	○	How **much**	○ A ○ B ○ C ○ D
Tuna, tuna salad, tuna casserole	○	○	○	○	○	○	○	○	○	How much **of the tuna**	○ A ○ B ○ C
Fried fish or fish sandwich	○	○	○	○	○	○	○	○	○	How **much**	○ A ○ B ○ C
Other fish, not fried	○	○	○	○	○	○	○	○	○	How **much**	○ A ○ B ○ C
BREADS											
Biscuits, muffins, croissants (not counting breakfast sandwiches with eggs)	○	○	○	○	○	○	○	○	○	How **many**	○ 1 sm ○ 1 med ○ 2
Hamburger buns, hotdog buns, hoagie buns, submarines	○	○	○	○	○	○	○	○	○	How **many**	○ 1 ○ 2
Bagels, English muffins, dinner rolls	○	○	○	○	○	○	○	○	○	How **many**	○ 1/2 ○ 1
Tortillas (not counting those eaten in tacos or burritos)	○	○	○	○	○	○	○	○	○	How many **in a day**	○ 1 ○ 2 ○ 3 ○ 4
Corn bread, corn muffins, hush puppies	○	○	○	○	○	○	○	○	○	How many **pieces in a day**	○ 1/2 ○ 1 ○ 2
Any other bread or toast, including white, dark, whole wheat, and what you have in sandwiches	○	○	○	○	○	○	○	○	○	How many **slices in a day**	○ 1 ○ 2 ○ 3 ○ 4
Rice, or dishes made with rice	○	○	○	○	○	○	○	○	○	How much **in a day**	○ B ○ C ○ D

	NEVER	A FEW TIMES per YEAR	ONCE per MONTH	2-3 TIMES per MONTH	ONCE per WEEK	2 TIMES per WEEK	3-4 TIMES per WEEK	5-6 TIMES per WEEK	EVERY DAY	HOW MUCH ON THOSE DAYS SEE PORTION SIZE PICTURES FOR A-B-C-D	
Margarine (not butter) on bread or on vegetables										How many pats (tsp)	1, 2, 3, 4
Butter (not margarine) on bread or on vegetables										How many pats (tsp)	1, 2, 3, 4
Energy bars, like Power Bars, Clif bars, Balance, Luna, Atkins bars										How many	1, 2
Breakfast bars, cereal bars, granola bars (not energy bars)										How many	1, 2
Peanuts, sunflower seeds, other nuts or seeds										How much	A, B, C
Peanut butter										How many tablespoons	1/2, 1, 2, 3
Snack chips like potato chips, tortilla chips, Fritos, Doritos, popcorn (not pretzels)										How much	A, B, C, D
Crackers, like Saltines, Cheez-Its, or any other snack cracker										How much	A, B, C
Jelly, jam										How many tablespoons	1/2, 1, 2
Mayonnaise, sandwich spreads										How many tablespoons	1/2, 1, 2
Catsup, salsa or chile peppers										How many tablespoons	1/2, 1, 2, 3
Mustard, barbecue sauce, soy sauce, gravy, other sauces										How many tablespoons	1/2, 1, 2, 3
Donuts										How many	1, 2, 3
Cake, or snack cakes like cupcakes, Ho-Hos, Entenmann's, or any other pastry										How many pieces	1 sm, 1 med, 2, 3
Cookies										How many	1-2, 3-4, 5-6, 7+
Ice cream, ice cream bars										How much	B, C, D
Chocolate syrup or sauce (like in milk or on ice cream)											
Pumpkin pie, sweet potato pie										How many pieces	1/2, 1, 2
Any other pie including fast food pies or snack pies										How many pieces	1/2, 1, 2
Chocolate candy like candy bars, M&Ms, Reeses										How much	1 mini, 1 med, 1 lrg, 1 king
Any other candy, not chocolate, like hard candy, Lifesavers, Skittles, Starburst										How much in a day	1-2 pcs, 1/2 pkg, 1 pkg

	NEVER	A FEW TIMES per YEAR	ONCE per MONTH	2-3 TIMES per MONTH	ONCE per WEEK	2 TIMES per WEEK	3-4 TIMES per WEEK	5-6 TIMES per WEEK	EVERY DAY	HOW MUCH on the days you drink it?	
Glasses of milk (any kind, including soy), not counting on cereal or coffee										How many GLASSES	1, 2, 3
Drinks like Slim Fast, Sego, Slender, Ensure or Atkins										How many CANS OR GLASSES	1, 2
Tomato juice or V-8 juice										How many GLASSES	1/2, 1, 2
Real 100% orange juice or grapefruit juice. Don't count orange soda or Sunny Delight										How many GLASSES	1/2, 1, 2
Apple juice, grape juice, pineapple juice or fruit smoothies										How many GLASSES	1/2, 1, 2

	NEVER	A FEW TIMES per YEAR	ONCE per MONTH	2-3 TIMES per MONTH	ONCE per WEEK	2 TIMES per WEEK	3-4 TIMES per WEEK	5-6 TIMES per WEEK	EVERY DAY	HOW MUCH on the days you drink it?
Hi-C, Cranberry Juice Cocktail, Hawaiian Punch, Tang	○	○	○	○	○	○	○	○	○	How many GLASSES: ○ 1/2 ○ 1 ○ 2 ○ 3
Drinks with some juice, like Sunny Delight, Knudsen	○	○	○	○	○	○	○	○	○	How many GLASSES: ○ 1/2 ○ 1 ○ 2 ○ 3
Iced tea, homemade, instant, or bottled like Nestea, Lipton, Snapple, Tazo	○	○	○	○	○	○	○	○	○	How many GLASSES OR BOTTLES: ○ 1 ○ 2 ○ 3 ○ 4
Kool-Aid, lemonade, sports drinks like Gatorade, or fruit flavored drinks (not including iced teas)	○	○	○	○	○	○	○	○	○	How much IN A DAY: ○ 1 glass ○ 1 20-ounce bottle ○ 2 glasses ○ 2 20-ounce bottles
Any kind of soft drink, like cola, Sprite, orange soda, regular or diet	○	○	○	○	○	○	○	○	○	How much IN A DAY: ○ 1 can ○ 1 20-ounce bottle ○ 2 cans ○ Big Gulp or 3 cans
Beer or non-alcoholic beer	○	○	○	○	○	○	○	○	○	How much IN A DAY: ○ 1 can ○ 2 cans ○ 3-4 cans or small pitcher ○ 5+ cans or large pitcher
Wine or wine coolers	○	○	○	○	○	○	○	○	○	How many GLASSES in a day: ○ 1/2 glass ○ 1 glass ○ 2 glasses or half bottle ○ 3 glasses
Liquor or mixed drinks	○	○	○	○	○	○	○	○	○	How many DRINKS: ○ 1 ○ 2 ○ 3 ○ 4
Glasses of water, tap or bottled	○	○	○	○	○	○	○	○	○	How many GLASSES: ○ 1 ○ 2 ○ 3-4 ○ 5+
Coffee, regular or decaf	○	○	○	○	○	○	○	○	○	How many CUPS: ○ 1 ○ 2 ○ 3 ○ 4+
Hot tea (not including herbal teas)	○	○	○	○	○	○	○	○	○	How many CUPS: ○ 1 ○ 2 ○ 3 ○ 4+

What do you usually add to **coffee?** **MARK ONLY ONE:**
○ Cream or half & half ○ Nondairy creamer ○ Milk ○ None of these ○ Don't drink it

What do you usually add to **tea?** **MARK ONLY ONE:**
○ Cream or half & half ○ Nondairy creamer ○ Milk ○ None of these ○ Don't drink it

Do you usually add sugar (or honey) to **coffee?** ○ No ○ Yes IF YES, how many teaspoons each cup? ○ 1 ○ 2 ○ 3 ○ 4

Do you usually add sugar (or honey) to **tea?** ○ No ○ Yes IF YES, how many teaspoons each cup? ○ 1 ○ 2 ○ 3 ○ 4

	RARELY	1-2 PER WEEK	3-4 PER WEEK	5-6 PER WEEK	1 PER DAY	1 1/2 PER DAY	2 PER DAY	3 PER DAY	4+ PER DAY
About how many servings of vegetables do you eat, per day or per week, not counting salad or potatoes?	○	○	○	○	○	○	○	○	○
About how many servings of fruit do you eat, not counting juices?	○	○	○	○	○	○	○	○	
How often do you use fat or oil in cooking?	○	○	○	○	○	○	○	○	

PLEASE DO NOT WRITE IN THIS AREA

SERIAL #

If you eat the following foods, what type do you usually eat? MARK ONLY ONE ANSWER FOR EACH QUESTION

Milk	○ Whole milk ○ Reduced-fat 2% milk	○ Low-fat 1% milk ○ Non-fat milk	○ Soy milk ○ Rice milk	○ Don't drink
Slim Fast, Sego, Slender or Ensure		○ Low-Carb like Atkins	○ Regular	○ Don't drink
Orange juice	○ Calcium-fortified	○ Not calcium-fortified	○ I don't know	○ Don't drink
Soda or pop	○ Diet soda, low-calorie	○ Regular	○ Don't drink	
Iced tea	○ Homemade, no sugar	○ Homemade, w/sugar	○ Bottled, no sugar ○ Bottled, regular	○ Don't drink
Beer	○ Regular beer ○ Light beer	○ Low-Carb beer	○ Non-alcoholic beer	○ Don't drink
Hamburgers or cheeseburgers		○ Hamburgers	○ Cheeseburgers	○ Don't eat
Hot dogs	○ Low fat or turkey dogs	○ Regular hot dogs	○ Don't eat	
Lunch meats	○ Low-fat or turkey lunch meats	○ Regular lunch meats	○ Don't eat	
Spaghetti or lasagna	○ Meatless	○ With meat sauce or meatballs		○ Don't eat
Cheese	○ Low Fat	○ Not Low Fat	○ Don't eat	
Salad dressing	○ Low-Carb	○ Low-fat	○ Regular	○ Don't use
Energy bars like Power Bar, Clif, Atkins	○ Low-Carb, low sugar	○ Low-fat	○ Regular	○ Don't eat
Breakfast bars, cereal bars, or granola bars	○ Low-Carb, low sugar	○ Low-fat	○ Regular	○ Don't eat
Bread	○ 100% whole wheat	○ Low-Carb	○ Regular	○ Don't eat
Tortillas	○ Corn	○ Flour	○ Don't know or don't eat	
Chocolate candy or chocolate candy bars	○ Low-Carb, low sugar	○ Low-fat	○ Regular	○ Don't eat
Cookies	○ Low-Carb, low sugar	○ Low-fat	○ Regular	○ Don't eat
Cake, snack cakes, and other pastries	○ Low-Carb, low sugar	○ Low-fat	○ Regular	○ Don't eat
Ice cream	○ Low-Carb, low sugar	○ Low-fat or ice milk	○ Regular	○ Don't eat
Jelly or jam	○ Low-Carb, low sugar	○ Regular	○ Don't use	
Beef or pork	○ Avoid eating the fat	○ Sometimes eat the fat	○ Often eat the fat	○ Don't eat
Chicken or Turkey	○ Avoid eating the skin	○ Sometimes eat the skin	○ Often eat the skin	○ Don't eat

What kinds of **fat or oil** do you usually use in cooking? **MARK ONLY ONE OR TWO**

- ○ Don't know, or Pam
- ○ Butter
- ○ Butter/margarine blend
- ○ Stick margarine
- ○ Soft tub margarine
- ○ Low-fat margarine
- ○ Corn oil, vegetable oil
- ○ Olive oil or canola oil
- ○ Lard, fatback, bacon fat
- ○ Crisco

If you eat **cold cereals**, what do you eat? Choose one or two that you eat most often. (If you usually just eat one kind, just choose one.)

- ○ Low-carb cereals like Atkins, <u>Low-Carb</u> Special K
- ○ Cheerios, Grape Nuts, Shredded Wheat, Wheaties, Wheat Chex
- ○ Total
- ○ Fiber One
- ○ Product 19, Complete
- ○ All Bran, Bran Buds
- ○ Other fiber cereals like Raisin Bran, Fruit-n-Fiber
- ○ Sweetened cereals like Frosted Flakes, Froot Loops
- ○ Other cold cereals, like Corn Flakes, Rice Krispies, Special K

What vitamin supplements do you take fairly regularly?

Multiple Vitamins. Did you take...	HOW OFTEN: DIDN'T TAKE	A FEW DAYS per MONTH	1-3 DAYS per WEEK	4-6 DAYS per WEEK	EVERY DAY	FOR HOW MANY YEARS?: LESS THAN 1 YEAR	1 YEAR	2 YEARS	3-4 YEARS	5-9 YEARS	10+ YEARS
Prenatal vitamins											
Regular Once-A-Day, Centrum, Theragran, "senior" vitamins or house brands of multiple vitamins											
Stress-tabs or B-Complex type											
Single Vitamins, not part of multiple vitamins											
Vitamin A (not beta-carotene)											
Beta-carotene											
Vitamin C											
Vitamin E											
Folic Acid, Folate											
Calcium or Tums											
Vitamin D, alone or combined with calcium											
Zinc											
Iron											
Selenium											
Omega-3, fish oil, flax seed oil											

If you took Once-a-day, Centrum or Thera-type multiple vitamins, did you usually take types that

- contain minerals, iron, zinc, etc.
- do not contain minerals
- Don't know

If you took vitamin C, how many milligrams of **vitamin C** did you usually take, on the days you took it?

100 · 250 · 500 · 750 · 1000 · 1500 · 2000 · 3000+ · Don't know

If you took vitamin E, how many IUs of **vitamin E** did you usually take, on the days you took it?

100 · 200 · 300 · 400 · 600 · 800 · 1000 · 2000+ · Don't know

Did you take any of these supplements at least once a week?

- Ginkgo
- Ginseng
- St. John's Wort
- Kava Kava
- Echinacea
- Melatonin
- DHEA
- Glucosamine/Chondroitin
- Didn't take these

SOME LAST QUESTIONS ABOUT YOU

Would you say your health is: Excellent · Very good · Good · Fair · Poor

Are you currently trying to lose weight? Yes · No

Was there ever a time in your life when you often drank more beer, wine or liquor than you do now? Yes · No

Do you smoke cigarettes now? Yes · No

IF YES, On average about how many cigarettes a day do you smoke now? 1-5 · 6-14 · 15-24 · 25-34 · 35+

Are you: Hispanic or Latino · Not Hispanic or Latino

What race do you consider yourself to be? (MARK ALL THAT APPLY)

- White
- Black or African American
- Asian
- American Indian or Alaska Native
- Native Hawaiian or Other Pacific Islander
- Do not wish to provide this information

Thank you very much for filling out this questionnaire.
Please take a minute to go back and fill in anything you may have skipped.

PLEASE DO NOT WRITE IN THIS AREA

SERIAL #

Appendix D: Data Dictionary Block 2005 Food Frequency Questionnaire

NutritionQuest

(formerly Block Dietary Data Systems)

www.NutritionQuest.com

Block 2005 Food Frequency Questionnaire

Online Analysis

All My Pyramid Food Groups
individual sugars
Fatty acids
Cholines

This is an ASCII or "Text" file with delimiters. Responses are separated by a semicolon. Each questionnaire and its analysis result is stored in one line of data, including both RAW scanned data and nutrient analysis results. A 10-character ID number identifies each respondent's data; no other identifiers appear on the files.

The list of variable names and descriptions reflects the order of appearance in the data file. A description of coded values and their meaning follows the variable

SCANNED RAW DATA: Identifier and demographics

1	RESPONDENTID	"Respondent ID (scanned RAW data)"
2	BOOKNUM	"Booklet Number (printed on paper FFQs)"
3	TODAYSDATE	"Date completed (MMDDYYYY), 8 characters, RAW"
4	SEX	"Sex 1=M, 2=F, M=missing, E=Multiple mark"
5	PREGNANT	"Pregnant? 1=N, 2=Y, 3=Not female"
6	AGE	"Age, years"
7	WEIGHT	"Scanned Weight (lbs.), 3 characters"
8	HEIGHTFEET	"Height, feet"
9	HEIGHTINCHES	"Height, inches"
10	BMI	"Body Mass Index"

DIET ANALYSIS OUTPUT VARIABLES

11	DT_KCAL	'Food energy, kcals'
12	DT_PROT	'Protein, gms'
13	DT_TFAT	'Fat, gms'
14	DT_CARB	'Carbohydrate, gms'
15	DT_CALC	'Calcium, mg'
16	DT_PHOS	'Phosphorus, mg'
17	DT_IRON	'Iron, mg'
18	DT_SODI	'Sodium, mg'
19	DT_POTA	'Potassium, mg'
20	DT_GSH_T	'Glutathione, total, mg'
21	DT_GSH_R	'Glutathione, reduced, mg'
22	DT_THIA	'Thiamin (Vitamn B1), mg'

23	DT_RIBO	'Riboflavin (Vitamin B2), mg'
24	DT_NIAC	'Niacin , mg'
25	DT_VITC	'Vitamin C, mg'
26	DT_SFAT	'Saturated fat, gms'
27	DT_MFAT	'Monounsaturated fatty acids, gms'
28	DT_PFAT	'Polyunsaturated fatty acids, gms'
29	DT_CHOL	'Cholesterol, mg'
30	DT_FIBE	'Dietary fiber, gms'
31	DT_SOLFIBR	"Dietary soluble fiber, gms"
32	DT_FOLFD	'Food folate, mcg'
33	DT_ATOC	'Vitamin E as alpha-tocopherol, mg'
34	DT_ZINC	'Zinc, total, mg'
35	DT_AN_ZN	'Zinc, animal sources only, mg'
36	DT_VITB6	'Vitamin B6, mg'
37	DT_MAGN	'Magnesium, mg'
38	DT_VARAE	'Vitamin A, RAE (mcg)'
39	DT_RET	'Retinol, mcg'
40	DT_ACARO	'Alpha-carotene, mcg'
41	DT_BCARO	'Beta-carotene, mcg'
42	DT_CRYPT	'Cryptoxanthin, beta, mcg'
43	DT_LUTZE	'Lutein-Zeaxanthin, mcg'
44	DT_LYCO	'Lycopene, mcg'
45	DT_FOLAC	'Folic acid, mcg'
46	DT_VB12	'Vitamin B-12, mcg'
47	DT_VITD	'Vitamin D, IU'
48	DT_VITK	'Vitamin K as phylloquinone, mcg'
49	DT_COPP	'Copper, mg'
50	DT_SEL	'Selenium, mcg'
51	DT_SUG_T	'Sugars, total, gms'
52	DT_TRFAT	'Trans fats, total, gms'
53	DT_ISOFLV	'Isoflavones, total, mg'
54	DT_QUERC	'Quercetin, mg'
55	DT_CYSTEN	'Cysteine (S-containing), mg'
56	DT_METHI	'Methionine (S-containing), mg'
57	DT_CYSTI	'Cystine (S-containing), mg'
58	FOL_DFE	'Average daily Dietary Folate Equivalents, mcg'
59	GI	'Glycemic Index (glucose), average daily'
60	GL	'Glycemic Load (glucose), average daily'
61	DT_ARGININE	"Dietary arginine, mg"
62	DT_FA182	"Dietary PUFA (~N-6) 18:2, gms"
63	DT_FA183	"Dietary PUFA (~N-3) 18:3, gms"
64	DT_FA184	"Dietary PUFA (~N-3) 18:4, gms"
65	DT_FA204	"Dietary PUFA (~N-6) 20:4, gms"
66	DT_FA205	"Dietary N-3 PUFA 20:5 (EPA), gms"
67	DT_FA225	"Dietary N-3 PUFA 22:5 (DPA), gms"
68	DT_FA226	"Dietary N-3 PUFA 22:6 (DHA), gms"
69	DT_TOTN6	"Avg. daily omega-6 FA, gms"
70	DT_TOTN3	"Avg. daily omega-3 FA, gms"

71	DT_fruct	'Fructose, gms'
72	DT_lact	'Lactose, gms'
73	DT_malt	'Maltose, gms'
74	DT_galac	'Galactose, gms'
75	DT_sucr	'Sucrose, gms'
76	DT_gluc	'Glucose, gms'
77	total_choline	"Total choline, mg"
78	free_choline	"Free choline, mg"
79	phosphocholine	"Phosphocholine, mg"
80	glycerophosphocholine_GPC	"Glycerophosphocholine (GPC), mg"
81	phosphatidylcholine_PTD	"Phosphatidylcholine (PTD), mg"
82	betaine	"Betaine, mg"

83	sphingomyelin_SM	"Sphingomyelin (SM), mg"

Quality Control Variables

84	GROUP_SOLID_COUNT	"# of solid foods respondent reported ever eating"
85	GROUP_SOLID_TOTAL_FREQUENCY	"Average total daily frequency of all solid foods"
86	GROUP_SOLID_TOTAL_GRAMS	'Grams of solid food, average daily'

Diet Summary Variables

87	PCTFAT	'% of kcal from fat'
88	PCTPROT	'% of kcal from protein'
89	PCTCARB	'% of kcal from carbohydrate'
90	PCTSWEET	'% of kcal from sweets, desserts'
91	PCTALCH	'% of kcal from alcoholic beverages'
92	BA_PFAT	'% fat kcals, alcoholic beverages not in denominator'
93	BA_PPROT	'% protein kcals, alc. beverages not in denominator'
94	BA_PCARB	'% carbohydrate kcals, alc. beverages not in denom.'
95	GROUP_BEANFIBER_TOTAL_FIBE	'Dietary fiber from beans, gms'
96	GROUP_VEGETABLESFRUITFIBER_TOTAL_FIBE	Dietary fiber from vegetables, fruits, gms'
97	GROUP_GRAINFIBER_TOTAL_FIBE	'Dietary fiber from grains, gms'

98	GROUP_SUGARYBEVG_TOTAL_GRAMS	'Avg. daily intake of sugary beverages, gms'
99	GROUP_SUGARYBEVG_TOTAL_KCAL	'Kilocalories per day from sugary beverages'
100	VEGSRV	'Daily servings of vegetables'
101	FRUITSRV	'Daily frequency of fruits & fruit juices'
102	GRAINSRV	'Daily svgs breads, cereals, rice, pasta'
103	MEATSRV	'Daily svgs meat, fish, poultry, beans, eggs'
104	DAIRYSRV	'Daily servings of milk, yogurt, cheese'
105	FATSRV	'Daily svgs fats & oils, sweets, sodas'
106	WGRAINS	'Average daily servings of whole grains'

Nutrients from Vitamin-Mineral Supplement

107	SUP_VITA	'Vit A from supplements, RAE (mcg)'
108	SUP_VITC	'Vit C from supplements, mg'
109	SUP_VITD	'Vit D from supplements, IU'
110	SUP_VITE	'Vit E from supplements, a-TE'
111	SUP_IRON	'Iron from supplements, mg'
112	SUP_CA	'Calcium from supplements, mg'
113	SUP_ZINC	'Zinc from supplements, mg'
114	SUP_BCAR	'Beta-carotene from supplements, mcg'
115	SUP_B1	'B-1 (Thiamin) from supplements, mg'
116	SUP_B6	'B-6 from supplements, mg'
117	SUP_B12	'B-12 from supplements, mcg'
118	SUP_FOL	'Folic acid from supplements, mcg'
119	SUP_CU	'Copper from supplements, mg'
120	SUP_SE	'Selenium from supplements, mcg'
121	SUP_B2	'Riboflavin from supplements, mg'
122	SUP_MG	'Magnesium from supplements, mg'
123	SUP_NIAC	'Niacin from supplements, mg'
124	SUP_OM_3	'Omega-3 fatty acids from supplements, gms'
125	SUP_OM_6	'Omega-6 fatty acids from supplements, gms'

My Pyramid Food Group Servings (2006) - complete

126	ADD_SUG	'"Added sugars, teaspoon equivalents"
127	A_BEV	"Alcohol drink-equiv. (about 13 g EtOH)"
128	DFAT_OIL	'"Discretionary fat, oil, grams"
129	DFAT_SOL	"Discretionary fat, solid, grams"
130	D_CHEESE	'"Cheese, milk-equivalent servings"
131	D_MILK	'"Milk, cups"
132	D_TOTAL	'"Total dairy, milk-equivalent servings"
133	D_YOGURT	'"Yogurt, cups"
134	F_CITMLB	'"Citrus melon berries, cups"
135	F_OTHER	'"Other fruit, cups"
136	F_TOTAL	'"Total fruit, cups"
137	F_SOLID	'"Solid fruit (not juice), cups"
138	F_JUICE	"Juices (including in fruit sodas), cups"
139	JUICE100	"Juices (only 100% juice), cups"
140	G_NWHL	'"Non-whole grains, ounce-equivalents"
141	G_TOTAL	'"Total grains, ounce-equivalents"
142	G_WHL	'"Whole grains, ounce-equivalents"
143	LEGUMES	'"Dry beans peas, cups"
144	M_EGG	'"Eggs, lean meat ounce-equivalents"
145	M_FISH_HI	"Fish seafood, high in omega-3, ounces"
146	M_FISH_LO	"Fish seafood, low in omega-3, ounces"
147	M_FRANK	'"Lunch meats, ounces"
148	M_MEAT	'"Beef pork lamb, ounces"
149	M_MPF	'"Meat fish poultry, ounces"
150	M_NUTSD	'"Nuts seeds, lean meat ounce-equivalents"
151	M_ORGAN	'"Organ meats, ounces"
152	M_POULT	'"Poultry, ounces"
153	M_SOY	'"Soy foods, cups"
154	V_DPYEL	'"Vegetables deep yellow orange, cups"
155	V_DRKGR	'"Vegetables dark green leafy, cups"
156	V_OTHER	'"Vegetables other, cups"
157	V_POTATO	'"Vegetables potatoes, cups"
158	V_STARCY	'"Vegetables starchy, cups"
159	V_TOMATO	'"Vegetables tomatoes, cups"
160	V_TOTAL	'"Total vegetables, cups"

My Pyramid Food Group Servings (2006) - modified for Nutrition Report

161	PSFRUIT	"My Pyramid Fruit - total, incl juice (cups)"
162	PSVEGNBP	"My Pyramid Veg - not legumes/potatoes (cups)"
163	PSVEGDKG	"My Pyramid Veg - dark green (cups)"
164	PSVEGORN	"My Pyramid Veg - orange (cups)"
165	PSLEGSOY	"My Pyramid Legumes, soy (cup equiv)"
166	PSVEGPOT	"My Pyramid Veg - potato (cups)"
167	PSVEGOTH	"My Pyramid Veg - other, incl tomatoes (cups)"
168	PSGTOT	"My Pyramid Grain - total (1-oz. equivalents)"
169	PSGWHL	"My Pyramid Grain - whole (1-oz. equiv.)"
170	PSMFP	"My Pyramid Meat - fish, chix, meat (1 oz.)"
171	PSNUTSD	"My Pyramid Nuts, seeds - (1-oz. meat equiv.)"
172	PSEGGS	"My Pyramid Eggs - meat equiv (1 egg = 1 oz.)"
173	PSDAIRY	"My Pyramid Dairy - milk, cheese (1 cup equiv.)"
174	PSOILS	"Beneficial Oils - dressings, fish, nuts, avocado (1 tsp)"

RAW QUESTIONNAIRE RESPONSE DATA

175	BREAKSANDFREQ	"Breakfast egg sandwich, frequency"
176	BREAKSANDQUAN	"Breakfast egg sandwich, quantity"
177	OTHEREGGSFREQ	"Other eggs, frequency"
178	OTHEREGGSQUAN	"Other eggs, quantity"
179	SAUSAGEFREQ	"Breakfast sausage, frequency"
180	SAUSAGEQUAN	"Breakfast sausage, quantity"
181	BACONFREQ	"Bacon, frequency"
182	BACONQUAN	"Bacon, quantity"
183	PANCAKESFREQ	"Pancakes, frequency"
184	PANCAKESQUAN	"Pancakes, quantity"
185	COOKEDCEREALFREQ	"Cooked Cereal, frequency"
186	COOKEDCEREALQUAN	"Cooked Cereal, quantity"
187	COLDCEREALFREQ	"Cold cereal, frequency"
188	COLDCEREALQUAN	"Cold cereal, quantity"
189	MILKONCEREALFREQ	"MILK ON CEREAL - SCANNED FREQUENCY"
190	YOGURTFREQ	"Yogurt, frequency"
191	YOGURTQUAN	"Yogurt, quantity"
192	CHEESEFREQ	"Cheese, frequency"
193	CHEESEQUAN	"Cheese, quantity"
194	BANANAFREQ	"Bananas, freq"
195	BANANAQUAN	"Bananas, quantity"
196	APPLESPEARSFREQ	"Apples, freq"
197	APPLESPEARSQUAN	"Apples, quantity"
198	ORANGESFREQ	"Oranges, freq"
199	ORANGESQUAN	"Oranges, quantity"
200	GRAPEFRUITFREQ	"Grapefruit, freq"
201	GRAPEFRUITQUAN	"Grapefruit, quantity"
202	PEACHESFREQ	"Peaches, raw, freq"
203	PEACHESQUAN	"Peaches, raw, quantity"
204	OTHERFRUITFREQ	"Other fresh fruit, freq"
205	OTHERFRUITQUAN	"Other fresh fruit, quantity"
206	CANNEDFRUITFREQ	"Canned fruit, freq"
207	CANNEDFRUITQUAN	"Canned fruit, quantity"
208	CANTALOUPEFREQ	"Cantaloupe, in season, freq"
209	CANTALOUPEQUAN	"Cantaloupe, in season, quantity"
210	STRAWBERRIESFREQ	"Strawberries, in season, freq"
211	STRAWBERRIESQUAN	"Strawberries, in season, quantity"
212	WATERMELONFREQ	"Watermelon, in season, freq"
213	WATERMELONQUAN	"Watermelon, in season, quantity"
214	BROCCOLIFREQ	"Broccoli, freq"
215	BROCCOLIQUAN	"Broccoli, quantity"

262	TOFUFREQ	"Tofu, freq"
263	TOFUQUAN	"Tofu, quantity"
264	MEATSUBSTITUTEFREQ	"Meat substitutes, freq"
265	MEATSUBSTITUTEQUAN	"Meat substitutes, quantity"
266	EATMEAT	"Ever eat meat (1=Yes, 2=No)"
267	BURGERFREQ	"Hamburger (cheeseburger), freq"
268	BURGERQUAN	"Hamburger (cheeseburger), quantity"
269	HOTDOGFREQ	"Hot dogs, freq"
270	HOTDOGQUAN	"Hot dogs, quantity"

271	BOLOGNAFREQ	"Lunch Meats, freq"
272	BOLOGNAQUAN	"Lunch Meats, quantity"
273	MEATLOAFFREQ	"Meat loaf, freq"
274	MEATLOAFQUAN	"Meat loaf, quantity"

216	CARROTSFREQ	"Carrots, freq"
217	CARROTSQUAN	"Carrots, quantity"
218	CORNFREQ	"Corn, freq"
219	CORNQUAN	"Corn, quantity"
220	BEANSPEASFREQ	"Green beans, freq"
221	BEANSPEASQUAN	"Green beans, quantity"
222	SPINACHCOOKEDFREQ	"Spinach, freq"
223	SPINACHCOOKEDQUAN	"Spinach, quantity"
224	GREENSFREQ	"Greens, freq"
225	GREENSQUAN	"Greens, quantity"
226	SWEETPOTATOESFREQ	"Sweet potato, freq"
227	SWEETPOTATOESQUAN	"Sweet potato, quantity"
228	FRIESFREQ	"French Fries, freq"
229	FRIESQUAN	"French Fries, quantity"
230	POTATOESFREQ	"Other potatoes, freq"
231	POTATOESQUAN	"Other potatoes, quantity"
232	COLESLAWCABBAGEFREQ	"Cole slaw, freq"
233	COLESLAWCABBAGEQUAN	"Cole slaw, quantity"
234	GREENSALADFREQ	"Green salad, freq"
235	GREENSALADQUAN	"Green salad, quantity"
236	TOMATOESFREQ	"Tomatoes, freq"
237	TOMATOESQUAN	"Tomatoes, quantity"
238	SALADDRESSINGFREQ	"Salad dressing, freq"
239	SALADDRESSINGQUAN	"Salad dressing, quantity"
240	OTHERVEGGIESFREQ	"Other vegetables, freq"
241	OTHERVEGGIESQUAN	"Other vegetables, quantity"
242	REFRIEDBEANSFREQ	"Refried beans, freq"
243	REFRIEDBEANSQUAN	"Refried beans, quantity"
244	PINTOBEANSFREQ	"Other beans, freq"
245	PINTOBEANSQUAN	"Other beans, quantity"
246	VEGGIESTEWFREQ	"Vegetable stew, freq"
247	VEGGIESTEWQUAN	"Vegetable stew, quantity"
248	VEGSOUPFREQ	"Vegetable soup, freq"
249	VEGSOUPQUAN	"Vegetable soup, quantity"
250	PEASOUPFREQ	"Bean soup, freq"
251	PEASOUPQUAN	"Bean soup, quantity"
252	OTHERSOUPFREQ	"Other soup, freq"
253	OTHERSOUPQUAN	"Other soup, quantity"
254	PIZZAFREQ	"Pizza, freq"
255	PIZZAQUAN	"Pizza, quantity"
256	SPAGHETTIFREQ	"Spaghetti with meat sauce, freq"
257	SPAGHETTIQUAN	"Spaghetti with meat sauce, quantity"
258	MACARONIFREQ	"Mac N Cheese, freq"
259	MACARONIQUAN	"Mac N Cheese, quantity"
260	OTHERNOODLESFREQ	"Other noodles, freq"
261	OTHERNOODLESQUAN	"Other noodles, quantity"

275	STEAKFREQ	"Beef, freq"
276	STEAKQUAN	"Beef, quantity"
277	TACOSFREQ	"Tacos, freq"
278	TACOSQUAN	"Tacos, quantity"
279	RIBSFREQ	"Ribs, freq"
280	RIBSQUAN	"Ribs, quantity"
281	PORKFREQ	"Pork, freq"
282	PORKQUAN	"Pork, quantity"
283	VEALFREQ	"Veal, lamb, frequency"
284	VEALQUAN	"Veal, lamb, quantity"
285	LIVERFREQ	"Liver, freq"
286	LIVERQUAN	"Liver, quantity"
287	FEETFREQ	"Pigs feet, variety meats, freq"
288	FEETQUAN	"Pigs feet, variety meats,quantity"
289	MENUDOFREQ	"Menudo, freq"
290	MENUDOQUAN	"Menudo, quantity"
291	MIXEDBEEFPORKFREQ	"Other beef dish, freq"
292	MIXEDBEEFPORKQUAN	"Other beef dish, quantity"
293	FRIEDCHICKENFREQ	"Fried chicken, freq"
294	FRIEDCHICKENQUAN	"Fried chicken, quantity"
295	NOTFRIEDCHICKENFREQ	"Roast chicken, freq"
296	NOTFRIEDCHICKENQUAN	"Roast chicken, quantity"
297	MIXEDCHICKFREQ	"Other chicken dishes, freq"
298	MIXEDCHICKQUAN	"Other chicken dishes, quantity"

299	OYSTERSFREQ	"Oysters, freq"
300	OYSTERSQUAN	"Oysters, quantity"
301	SHELLFISHFREQ	"Shellfish, freq"
302	SHELLFISHQUAN	"Shellfish, quantity"
303	TUNAFREQ	"Tuna, freq"
304	TUNAQUAN	"Tuna, quantity"
305	FRIEDFISHFREQ	"Fried fish, freq"
306	FRIEDFISHQUAN	"Fried fish, quantity"
307	NOTFRIEDFISHFREQ	"Other fish, freq"
308	NOTFRIEDFISHQUAN	"Other fish, quantity"
309	BISCUITSFREQ	"Biscuits, freq"
310	BISCUITSQUAN	"Biscuits, quantity"
311	BUNSFREQ	"Burger rolls, freq"
312	BUNSQUAN	"Burger rolls, quantity"
313	BAGELFREQ	"Bagels, English muffins, freq"
314	BAGELQUAN	"Bagels, English muffins, quantity"
315	TORTILLASFREQ	"Tortillas (flour), freq"
316	TORTILLASQUAN	"Flour tortillas, quantity"
317	CORNBREADFREQ	"Corn bread, freq"
318	CORNBREADQUAN	"Corn bread, quantity"
319	OTHERBREADFREQ	"White bread, freq"
320	OTHERBREADQUAN	"White bread, quantity"
321	RICEFREQ	"Rice, freq"
322	RICEQUAN	"Rice, quantity"
323	MARGARINEFREQ	"Margarine, freq"
324	MARGARINEQUAN	"Margarine, quantity"
325	BUTTERFREQ	"Butter, freq"
326	BUTTERQUAN	"Butter, quantity"
327	POWERBARSFREQ	"Power bars, freq"
328	POWERBARSQUAN	"Power bars, quantity"
329	BREAKFASTBARSFREQ	"Breakfast bars, freq"
330	BREAKFASTBARSQUAN	"Breakfast bars, quantity"
331	NUTSFREQ	"Nuts, freq"
332	NUTSQUAN	"Nuts, quantity"
333	PEANUTBUTTERFREQ	"Peanut butter, freq"
334	PEANUTBUTTERQUAN	"Peanut butter, quantity"
335	SALTYSNACKSFREQ	"Chips, freq"

336	SALTYSNACKSQUAN	"Chips, quantity"
337	CRACKERFREQ	"Crackers, freq"
338	CRACKERQUAN	"Crackers, quantity"
339	JELLYFREQ	"Jelly, freq"
340	JELLYQUAN	"Jelly, quantity"
341	MAYOFREQ	"Mayonnaise, freq"
342	MAYOQUAN	"Mayonnaise, quantity"
343	SALSAFREQ	"Catsup, freq"
344	SALSAQUAN	"Catsup, quantity"
345	MUSTARDFREQ	"Mustard, freq"
346	MUSTARDQUAN	"Mustard, quantity"
347	DONUTFREQ	"Donuts, freq"
348	DONUTQUAN	"Donuts, quantity"
349	CAKEFREQ	"Cake, freq"
350	CAKEQUAN	"Cake, quantity"
351	COOKIESFREQ	"Cookies, freq"
352	COOKIESQUAN	"Cookies, quantity"
353	ICECREAMFREQ	"Ice cream, freq"
354	ICECREAMQUAN	"Ice cream, quantity"
355	CHOCOLATESYRUPFREQ	"Chocolate syrup, freq"
356	CHOCOLATESYRUPQUAN	"Chocolate syrup, quantity"
357	PUMPKINPIEFREQ	"Pumpkin Pie, freq"
358	PUMPKINPIEQUAN	"Pumpkin Pie, quantity"
359	OTHERPIEFREQ	"Other pie, freq"
360	OTHERPIEQUAN	"Other pie, quantity"
361	CHOCOLATECANDYFREQ	"Chocolate candy, freq"
362	CHOCOLATECANDYQUAN	"Chocolate candy, quantity"
363	CANDYFREQ	"Other candy, freq"
364	CANDYQUAN	"Other candy, quantity"
365	MILKFREQ	"Milk (default 2%), freq"
366	MILKQUAN	"Milk (default 2%), quantity"
367	DIETSHAKESFREQ	"Slimfast, freq"
368	DIETSHAKESQUAN	"Slimfast, quantity"
369	TOMATOJUICEFREQ	"Tomato juice, freq"
370	TOMATOJUICEQUAN	"Tomato juice, quantity"
371	ORANGEJUICEFREQ	"Real orange juice, freq"
372	ORANGEJUICEQUAN	"Real orange juice, quantity"
373	REALJUICEFREQ	"Other real juice, freq"
374	REALJUICEQUAN	"Other real juice, quantity"
375	HICFREQ	"Hi C, freq"
376	HICQUAN	"Hi C, quantity"
377	SOMEJUICEFREQ	"Drinks with some juice, freq"
378	SOMEJUICEQUAN	"Drinks with some juice, quantity"
379	ICEDTEAFREQ	"Ice tea, freq"
380	ICEDTEAQUAN	"Ice tea, quantity"
381	KOOLAIDFREQ	"Kool aid, freq"
382	KOOLAIDQUAN	"Kool aid, quantity"
383	SOFTDRINKSFREQ	"Sodas, freq"
384	SOFTDRINKSQUAN	"Sodas, quantity"
385	BEERFREQ	"Beer, freq"
386	BEERQUAN	"Beer, quantity"
387	WINEFREQ	"Wine, freq"
388	WINEQUAN	"Wine, quantity"
389	LIQUORFREQ	"Liquor, freq"
390	LIQUORQUAN	"Liquor, quantity"
391	WATERFREQ	"Water, freq"
392	WATERQUAN	"Water, quantity"
393	COFFEEFREQ	"Coffee, freq"
394	COFFEEQUAN	"Coffee, quantity"
395	HOTTEAFREQ	"Hot tea, freq"
396	HOTTEAQUAN	"Hot tea, quantity"
397	CREAMINCOFFEE	"Cream/milk in coffee"
398	CREAMINTEA	"Cream/milk in tea"

399	SUGARINCOFFEE	"Sugar in coffee: 1=No, 2=Yes"
400	COFFEESUGARTEASPOONS	"Teaspoons: sugar in coffee"
401	SUGARINTEA	"Sugar in tea: 1=No, 2=Yes"
402	TEASUGARTEASPOONS	"Teaspoons: sugar in tea"

403	VEGGIESFREQ	"How many vegetables eaten per day/week"
404	FRUITSFREQ	"How many fruits eaten per day or week"
405	FATOILFREQ	"How often use fat/oil in cooking"
406	MILKTYPE	"What type of milk"
407	DIETSHAKESTYPE	"Type of Slim Fast: low-carb, regular"
408	ORANGEJUICETYPE	"Type of OJ: with Calcium or regular"
409	SOFTDRINKSTYPE	"Type of Soda: diet/low-cal, regular"
410	ICEDTEATYPE	"Type of tea: home, bottled, sugar, not"
411	BEERTYPE	"Beer: reg., lite, low-carb, no-alc"
412	BURGERTYPE	"Type Hamburger: just beef, w cheese"
413	HOTDOGTYPE	"HotDogs: low-fat/turkey, regular"
414	BOLOGNATYPE	"Type LunchMeat: low-fat/turkey, reg."
415	SPAGHETTITYPE	"Type Spaghetti: meatless, meat/balls"
416	CHEESETYPE	"Type of Cheese: low-fat, regular"
417	SALADDRESSTYPE	"Salad Dressg: low-carb, low-fat, reg."
418	POWERBARSTYPE	"EnergyBars: low-carb, low-fat, regular"
419	BREAKFASTBARSTYPE	"BreakfastBars: low-carb, low-fat, reg."
420	BREADTYPE	"Bread: 100% whole grain, low-carb, reg."
421	TORTILLATYPE	"Type of Tortillas: corn, flour"
422	CHOCCANDYTYPE	"ChocolateCandy: low-car, low-fat, reg."
423	COOKIESTYPE	"Cookies: low-carb, low-fat, reg."
424	CAKETYPE	"Cake: low-carb, low-fat, regular"
425	ICECREAMTYPE	"Ice Cream: low-carb, low-fat, regular"
426	JELLYTYPE	"Jelly: low-carb/low sugar, regular"
427	FATONMEATTYPE	"How often eat fat on meat"
428	CHICKENSKINTYPE	"How often eat skin on chicken"
429	COOKINGFATPAMORNONE	"Cooking Fat - PAM OR NO OIL"
430	COOKINGFATBUTTER	"Cooking Fat - Butter"
431	COOKINGFATHALF	"Cooking Fat - Butter/marg. blend"
432	COOKINGFATSTICKMARG	"Cooking Fat - Stick margarine."
433	COOKINGFATSOFTMARG	"Cooking Fat - Soft tub margarine"
434	COOKINGFATDIET	"Cooking Fat - Lowfat margarine"
435	COOKINGFATVEGGIE	"Cooking Fat - Corn oil"
436	COOKINGFATOLIVE	"Cooking Fat - Olive oil"
437	COOKINGFATLARD	"Cooking Fat - Lard"
438	COOKINGFATCRISCO	"Cooking Fat - Crisco"
439	LCCEREALTYPE	"Cold cereal type: Low-carb (165)"
440	CHEERIOSTYPE	"Cold cereal type: Cheerios (166)"
441	TOTALTYPE	"Cold cereal type: Total (167)"
442	FIBERONETYPE	"Cold cereal type: Fiber (168)"
443	PRODUCT19TYPE	"Cold cereal type: Product 19 (169)"
444	ALLBRANTYPE	"Cold cereal type: Bran (170)"
445	OTHERFIBERTYPE	"Cold cereal type: Other fiber (171)"
446	SWEETENEDTYPE	"Cold cereal type: Sweetened (172)"
447	CORNFLAKESTYPE	"Cold cereal type: Other (007)"
448	PRENATALAMOUNT	"How often Prenatal vitamins type"
449	PRENATALYEARS	"Number of Years: Prenatal vitamins"
450	ONEADAYAMOUNT	"How often One-A-Day type w minerals"
451	ONEADAYYEARS	"Number of Years: One-A-Day w minerals"
452	STRESSTABSAMOUNT	"How often Stress-Tabs, B-complex type"
453	STRESSTABSYEARS	"Number of Years: Stress-Tabs/B-complex"

454	VITAMINAAMOUNT	"How often Vitamin A"
455	VITAMINAYEARS	"Number of Years of Vitamin A type"
456	BETACAROTENEAMOUNT	"How often Beta-Carotene"
457	BETACAROTENEYEARS	"Number of Years: Beta-Carotene type"
458	VITAMINCAMOUNT	"How often Vitamin C"
459	VITAMINCYEARS	"Number of Years: Vitamin C type"
460	VITAMINEAMOUNT	"How often Vitamin E"
461	VITAMINEYEARS	"Number of Years: Vitamin E type"
462	FOLATEAMOUNT	"How often Folate"
463	FOLATEYEARS	"Number of Years: Folate type"
464	CALCIUMAMOUNT	"How often Calcium/Dolomite"
465	CALCIUMYEARS	"Number of Years: Calcium/Dolomite"
466	VITAMINDAMOUNT	"How often Vitamin D, alone, w Calcium"
467	VITAMINDYEARS	"Number of Years: Vitamin D"
468	ZINCAMOUNT	"How often Zinc"
469	ZINCYEARS	"Number of Years: Zinc type"
470	IRONAMOUNT	"How often Iron"
471	IRONYEARS	"Number of Years: Iron type"
472	SELENIUMAMOUNT	"How often Selenium"
473	SELENIUMYEARS	"Number of Years: Selenium type"
474	OMEGA3AMOUNT	"How often Omega-3, fish/flax seed oil"
475	OMEGA3YEARS	"Number Years: Omega-3, fish/flax oil"
476	MINERALSYESORNO	"Minerals Y/N: 1=With, 2=W/O, M=DK"
477	MGVITAMINCPERDAY	"How many Mg per Vitamin C tablet"
478	MGVITAMINEPERDAY	"How many IU per Vitamin E capsule"
479	GINKO	"Ginkgo"
480	GINSENG	"Ginseng"
481	STJOHNSWORT	"St. John's Wort"
482	KAVAKAVA	"Kava Kava"
483	ECHINACEA	"Echinacea"
484	MELATONIN	"Melatonin"
485	DHEA	"DHEA"
486	GLUCOSAMINE	"Glucosamine/Chondroitin"
487	DIDNTTAKETHESESUPPS	"Didn't take these supps"
	Health Habits, and Ethnicity	
488	HEALTHSTATUS	"Would you say your health is "
489	LOSEWEIGHT	"Currently trying to lose weight?"
490	EVERDRANKMORE	"Ever drink more than currently?"
491	SMOKENOW	"Smoke cigarettes now?"
492	HOWMANYCIGS	"If so, how many cigarettes?"
493	LATINO	"Are you Hispanic or Latino?"
494	WHITE	"Are you White?"
495	BLACK	"Are you African American/Black?"
496	ASIAN	"Are you Asian?"
497	NATIVEAMER	"Are you American Indian or Alaskan Native?"
498	HAWAIIAN	"Are you Native Hawaiian or Pacific Islander?"
499	NOTPROVIDED	"Do not want to provide Race/Ethnicity info"

General Coding Information - RAW data

Food Questions generate two variables:

- o 1st variable for frequency response,
- o 2nd variable for portion size response.

MISSING and ERROR Codes.

Missing Code: M
Error Code: E (Respondent marked two bubbles)

If questions were omitted by the respondent, or marked in ink, or marked too lightly with pencil, they are perceived as missing by the scanner, and the field is given a code of "M".
They contribute nothing to the nutrient analyses.
E is used to indicate a scanning error, mainly to indicate that 2 or more choices have been shaded for a question when only 1 valid response was expected.

RESPONDENT ID
1-9 Identification Number
10 Blank

TODAY'S DATE
8 Characters = MMDDYYYY

SEX
1 = Male
2 = Female

PREGNANT/BREASTFEEDING
1 = No
2 = Yes
3 = Not female

AGE
2-digit age

WEIGHT
(pounds)
Up to 3 digits

HEIGHT
Feet (1 digit)
Inches (2 digits, 00-11)

BOOKLET NUMBER

A unique eight-digit number is printed on paper questionnaire booklets. These numbers may be used to confirm that the pages of two different booklets have not been mixed up.

FOOD LIST

Food Questions generate two variables:

- o 1st variable for frequency response,
- o 2nd variable for portion size response.

Coding Scheme for Food Frequency questions

1 = Never
2 = 6.0 per year
3 = 1.0 per Month
4 = 28.0 per Year
5 = 1.0 per Week
6 = 2.0 per Week
7 = 13.0 per Month
8 = 22.0 per Month
9 = 1.0 per Day

Coding Scheme for Serving Sizes

For foods asked as A,B,C,D

1 = 1/4 cup of food
2 = 1/2 cup of food
3 = 1 cup of food
4 = 2 cups of food

For all other foods, and beverages

Coded from left to right as 1,2,3,4. Refer to portion size prompts for each food for coding equivalents.

Do you EVER eat chicken, meat or fish?

1 = Yes
2 = No

Type of milk or cream added to coffee and tea

1 = Cream or half & half
2 = Nondairy creamer
3 = Milk
4 = None of these
M = Don't drink it

Sugar or honey added to coffee and tea

1 = No
2 = Yes

Number of teaspoons sugar or honey added to coffee and tea

1 = 1
2 = 2
3 = 3
4 = 4

SUMMARY QUESTIONS

Each of the summary questions ("About how many servings of vegetables do you eat", etc.) is coded as follows:

1 = Rarely
2 = 1-2 per week
3 = 3-4 per week
4 = 5-6 per week
5 = 1 per day
6 = 1.5 per day
7 = 2 per day
8 = 3 per day
9 = 4+ per day
M = Missing

LOW FAT FOODS AND OTHER "ADJUST" QUESTIONS

Refer to variable list above for file

locations. Type of milk
1 = Whole milk
2 = Reduced fat 2%
3 = Low fat 1%
4 = Non-fat
5 = Soy milk
6 = Rice milk
7 = Don't drink milk
M = Missing

Type of Slim fast, Sego, Ensure
1 = Low carb
2 = Regular
M = Don't drink

Type of orange juice
1 = Calcium fortified
2 = Not calcium fortified
M = Don’t know
M = Don’t drink

Type of soda or pop
1 = Diet soda
2 = Regular
M = Don’t drink

Type of iced tea
1 = Homemade, no sugar
2 = Homemade, with sugar
3 = Bottled, no sugar
4 = Bottled, regular
M = Don't drink

Type of beer
1 = Regular beer
2 = Light beer
3 = Low-carb beer
4 = Non-alcoholic beer
M = Don’t drink

Type of hamburger or cheeseburger

1 = Hamburger
2 = Cheeseburger
M = Don’t eat

<u>Type of hot dogs</u>
1 = Low fat or turkey dogs
2 = Regular hot dogs
M = Don’t eat

<u>Type of lunch meats</u>
1 = Low fat or turkey lunch meats
2 = Regular lunch meats
M = Don’t eat

<u>Type of spaghetti or lasagna</u>
1 = Meatless
2 = With meat sauce or meatballs
M = Don’t eat

<u>Type of cheese</u>
1 = Low fat
2 = Not low fat
M = Don’t eat

<u>Type of salad dressing</u>
1 = Low carb
2 = Low fat
3 = Regular
M = Don’t use

<u>Type of energy bars</u>
1 = Low carb, low sugar
2 = Low fat
3 = Regular
M = Don’t use

<u>Type of breakfast bars</u>
1 = Low carb, low sugar
2 = Low fat
3 = Regular
M = Don’t use

<u>Type of bread</u>
1 = 100% whole wheat
2 = Low carb
3 = Regular
M = Don’t use

<u>Type of tortillas</u>
1 = Corn
2 = Flour
3 = Don’t know or don't eat

<u>Type of chocolate candy</u>
1 = Low carb, low sugar
2 = Low fat
3 = Regular
M = Don’t use

<u>Type of cookies</u>
1 = Low carb, low sugar
2 = Low fat
3 = Regular
M = Don't use

<u>Type of cake, snack cakes, pastries</u>
1 = Low carb, low sugar
2 = Low fat
3 = Regular
M = Don't use

<u>Type of ice cream</u>
1 = Low carb, low sugar
2 = Low fat or ice milk
3 = Regular
M = Don't use

<u>Type of jelly/jam</u>
1 = Low carb, low sugar
2 = Regular
M = Don't use

<u>Fat on Beef/pork AND Skin on chicken/turkey</u>
1 = Avoid eating
2 = Sometimes eat
3 = Often eat
M = Don't eat meat/chicken, or missing

TYPE OF COOKING FAT

Each of the fat types is coded as follows:
0 = Not Marked
1 = Marked (selected by the respondent)

Refer to variable list above for fats and their file locations.

TYPE OF COLD CEREAL

Each of the cereal types is coded as follows:
0 = Not Marked
1 = Marked (selected by the respondent)

Refer to variable list above for cereals and their file locations.

VITAMIN FREQUENCIES

Refer to variable list above for vitamins and their file locations.

For each supplement, there are two data elements as follows:

How Often?
1 = Don't take
2 = 1-3 days per week
3 = 4-6 per week
4 = Every day

For How Many Years?
1 = Less than 1 year
2 = 1 year
3 = 2 years
4 = 3-4 years
5 = 5-9 years
6 = 10+ years

TYPE OF MULTIPLE VITAMIN

1 = Contain minerals
2 = Do not contain minerals
M = Don't know

UNITS PER TABLET

How many milligrams Vitamin C per day?
1 = 100 mg
2 = 250 mg
3 = 500 mg
4 = 750 mg
5 = 1000 mg
6 = 1500 mg
7 = 2000 mg
8 = 3000+ mg
M = Don't know

How many units (I.U.) Vitamin E per day?
1 = 100 I.U.
2 = 200 I.U.
3 = 300 I.U.
4 = 400 I.U.
5 = 600 I.U.
6 = 800 I.U.
7 = 1000 I.U.
8 = 2000+ I.U. M = Don't know

BOTANICALS

Each of the botanicals is coded as follows:
0 = Not Marked
1 = Marked (selected by the respondent)

Refer to variable list above for botanicals and their file locations.

HEALTH HABITS AND ETHNICITY QUESTIONS

SELF-ASSESSED HEALTH STATUS
1 = Excellent
2 = Very Good
3 = Good
4 = Fair
5 = Poor

ARE YOU CURRENTLY TRYING TO LOSE WEIGHT?
1 = Yes
2 = No

DID YOU EVER DRINK MORE BEER WINE OR LIQUOR THAN YOU DO NOW?
1 = Yes
2 = No

SMOKING

Smoke now?
1 = Yes
2 = No

How many now?
1 = 1-5
2 = 6-14
3 = 15-24
4 = 25-34
5 = 35 or more

ARE YOU HISPANIC OR LATINO
1 = Hispanic or Latino
2 = Not Hispanic or Latino

RACE/ETHNICITY

Each of the Race/Ethnicity questions is coded as follows:
0 = Not marked by the respondent
1 = Marked by the respondent

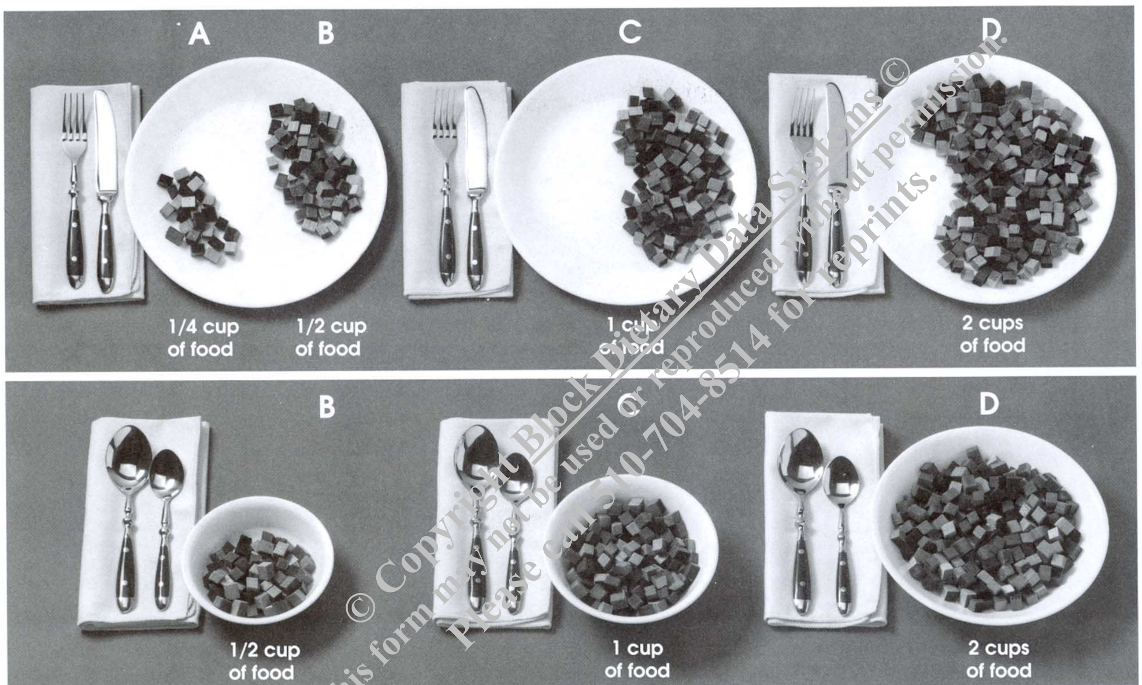
Appendix E: Portion Size Picture Sample

FOOD QUESTIONNAIRE

Serving Size Choices

Keep this in front of you while you are filling out The Food Questionnaire. You may use either the plates or the bowls to help you choose your serving size.

Choose A, B, C or D: **A** = 1/4 Cup of Food **B** = 1/2 Cup of Food **C** = 1 Cup of Food **D** = 2 Cups of Food



Appendix F: Perceived Stress Scale Questionnaire

Perceived Stress Scale

The questions in this scale ask you about your feelings and thoughts during the last month. In each case, you will be asked to indicate by circling how often you felt or thought a certain way.

Name ________________________________Date _________ Age _____

Gender (Circle): M F Other ____________________________________

0 = Never 1 = Almost Never 2 = Sometimes 3 = Fairly Often 4 = Very Often

1. In the last month, how often have you been upset□because of something that happened unexpectedly?	**0**	**1**	**2**	**3**	**4**
2. In the last month, how often have you felt that you were unable□to control the important things in your life?	**0**	**1**	**2**	**3**	**4**
3. In the last month, how often have you felt nervous and "stressed"?	**0**	**1**	**2**	**3**	**4**
4. In the last month, how often have you felt confident about your ability□to handle your personal problems?	**0**	**1**	**2**	**3**	**4**
5. In the last month, how often have you felt that things□were going your way?	**0**	**1**	**2**	**3**	**4**
6. In the last month, how often have you found that you could not cope□with all the things that you had to do?	**0**	**1**	**2**	**3**	**4**
7. In the last month, how often have you been able to control irritations in your life?	**0**	**1**	**2**	**3**	**4**
8. In the last month, how often have you felt that you were on top of things?	**0**	**1**	**2**	**3**	**4**
9. In the last month, how often have you been angered□because of things that were outside of your control?	**0**	**1**	**2**	**3**	**4**
10. In the last month, how often have you felt difficulties□were piling up so high that you could not overcome them?	**0**	**1**	**2**	**3**	**4**

Permission for use of scales is not necessary when use is for academic research or educational purposes.The PSS Scale is reprinted with permission of the American Sociological Association, from Cohen, S., Kamarck, T., & Mermelstein, R. (1983). A global measure of perceived stress. ***Journal of***

Health and Social Behavior, 24, 386-396. Retrieved from http://www.psy.cmu.edu/%7Escohen/globalmeas83.pdf

Appendix G: Demographic Questionnaire

ALLIED HEALTH AND NURSING STUDENT DEMOGRAPHIC FACTORS

Name_______________________________
Date__________________________

Keiser Student Id Number:______________________________

1. What type of Allied Health student are you?

   ☐ Nursing
   ☐ Nuclear Medicine Tech
   ☐ Sports Medicine
   ☐ Occupational Medicine
   ☐ Medical Assistant
   ☐ Radiology Tech

2. Which Semester are you currently enrolled?

   ☐ First
   ☐ Second
   ☐ Third
   ☐ Fourth
   ☐ Fifth
   ☐ Sixth

3. What is your gender?

   ☐ Female
   ☐ Male

4. How old are you?

   ☐ 18-21 years
   ☐ 22-25 years
   ☐ 26-30 years
   ☐ 31-34 years
   ☐ 35-39 years
   ☐ 40-43 years
   ☐ 44-47 years
   ☐ 48 year or more

5. What is your marital status?

   □ Never Married
   □ Married
   □ Divorced
   □ Widowed
   □ Domestic partner/Same sex marriage

6. Who do you live with?
   □ Live by myself
   □ Live with roommate(s)
   □ Live with spouse or significant other
   □ Live with spouse or significant other and children
   □ Live with parents
   □ Live with children only

7. How many persons live in your household?

   □ One
   □ Two
   □ Three
   □ Four
   □ Five
   □ Six
   □ Seven or-more

8. Are you currently working?

   □ No
   □ Yes, less than 10 hours a week
   □ Yes, between 10-20 hours per week
   □ Yes, between 21-30 hours per week
   □ Yes, between 31-40 hours per week
   □ Yes, more than 40 hours per week

9. What is your yearly total household income?

   □ $15,000/year or less
   □ $15,001-$30,000/year
   □ $30,001-$45,000/year
   □ $45,001-$60,000/year
   □ $60,001-$75,000/year
   □ $75,001-$90,000/year

☐ $90,000year or over

10. Is your household income based on

☐ Parents Income (Dependent)
☐ Yourself (Independent)
☐ Joint Income

11. Do feel like your dietary intake is based upon what you can afford?

☐ Yes
☐ Sometimes
☐ Never

12. Do you ever find that your dietary selections are based upon price?

☐ Yes
☐ Sometimes
☐ Never

13. How often are your dietary intake choices based upon what you can offered during the week?

☐ Always
☐ Sometimes
☐ Never

14. What is your race/ethnicity background?

☐ Caucasian
☐ African American
☐ Asian Pacific Islander
☐ Haitian
☐ Native American
☐ Hispanic/Latino
☐ Other___________________

15. On average, how many hours per day do you spend studying?

☐ Less than 2 hours
☐ 3-4 hours
☐ 5-6 hours
☐ More than 7 hours

16. How many hours do you spend each week in class (please include your clinical rotations)?

    □ Less than 10 hours per week
    □ 11-15 hours per week
    □ 16-20 hours per week
    □ 21-25 hours per week
    □ More than 26 hours per week

17. On average, how many hours of sleep each night do you get?

    □ Less than 4 hours
    □ 5-7 hours
    □ 8-10 hours
    □ More than 10 hours

Appendix H: Permissions, License/Memorandum Agreements, NIH Certification

Keiser University Approval

KEISER UNIVERSITY

1900 W. Commercial Blvd.
Suite 180
Ft. Lauderdale, Florida 33309
Telephone: 954-776-4476
Fax: 954-351-4045

June 24, 2013

Dr. Grisseel Cruz-Espaillat
2101 NW 117th Avenue
Miami, FL 33172

Dear Dr. Cruz-Espaillat,

We have reviewed your research proposal entitled, *A Cross-Sectional Study: Dietary Micronutrient Levels in Allied Health and Nursing Students,* and approve your research prospectus for use at Keiser University. Dr. Gary Markowitz, President of the Miami campus will oversee the coordination of this project and also be responsible for any data elements you need to assist with this project. Before beginning your work, you must submit a copy of the Walden University IRB approval for our institutional records.

This research has the potential to provide important information about students at career-focused institutions. We look forward to seeing the results of this work.

Sincerely,

William F. Ritchie, Ph.D.
Vice Chancellor of Academic Affairs

Micronutrient and Mineral Tables Permission

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SAGE

Title: Micronutrient Supplementation in Adult Nutrition Therapy: Practical Considerations

Author: Krishnan Sriram, Vassyl A. Lonchyna

Publication: Journal of Parenteral and Enteral Nutrition

Publisher: Sage Publications

Date: 09/01/2009

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NutritionQuest
15 Shattuck Square, Suite 288, Berkeley, CA 94704-1151
Phone 510-704-8514 / Fax 510-704-8996
www.NutritionQuest.com

February 1, 2013
Revised August 2, 2013

Memorandum of Understanding
Regarding Use of NutritionQuest's Online Applications –
Block Fruit-Vegetable-Fiber Screener © and Block 2005 FFQ ©
For study entitled: "Determining the Level of Micronutrients in Allied Health and Nursing Students by Measuring Dietary Intake: A Cross-Sectional Study to Examine Micronutrient Deficiencies"

This is a memorandum of understanding between NutritionQuest, located at 15 Shattuck Square, Suite 288 Berkeley, CA 94704-1151, and Grisseel Cruz-Espaillat, M.D., M.P.H., located at 9898 N.W. 133 Street, Hialeah Gardens, FL 33018, who agrees to the following terms and conditions.

1) Dr. Cruz-Espaillat has a nonexclusive right to use NUTRITIONQUEST's Online Applications – Block Fruit-Vegetable-Fiber Screener © and Block 2005 FFQ © (hereafter referred to as SCREENER and FFQ) solely for data collection, management and analysis for her study entitled "Determining the Level of Micronutrients in Allied Health and Nursing Students by Measuring Dietary Intake: A Cross-Sectional Study to Examine Micronutrient Deficiencies."
2) Use of SCREENER and FFQ is not transferrable to any other party.
3) Dr. Cruz-Espaillat agrees to use reasonable efforts to protect the SCREENER and FFQ from unauthorized use.
4) NutritionQuest retains title to its copyrighted SCEENER and FFQ.
5) Dr. Cruz-Espaillat acknowledges that the SCREENER and FFQ contain valuable confidential and proprietary information as well as copyrights.
6) Dr. Cruz-Espaillat will pay NutritionQuest the standard fees charged for use of FFQ: (a) a one-time account set-up fee of $250; (b) account maintenance fees of $50 per month; and (c) administration / analysis fees of $6 per online sessions begun (whether completed or not). She will be invoiced by the online system monthly. For use of SCREENER, she will pay NutritionQuest: (a) account maintenance fees of $25 per month; and (c) administration / analysis fee of $3.50 per online session (whether completed or not). The account set-up fee will be waived for the SCREENER.

Signed: Date: August 2, 2013

____
Torin Block, Chief Executive Officer

Perceived Stress Scale Permission

AMERICAN SOCIOLOGICAL ASSOCIATION

Permission No. 006146

Date: June 26, 2013

1430 K Street NW, Suite 600
Washington, DC 20005

(202) 383-9005 • fax (202) 638-0882
permissions@asanet.org

Requestor's Name: Grisseel Cruz-Espaillat, M.D.,M.P.H.
Address: 9898 N.W. 133 Street
Hialeah, Florida 33018

PERMISSION GRANTED
6/27/13

Your Ref.:

Author(s) of original work: Sheldon Cohen, Tom Kamarck and Robin Mermelstein
Title & Journal Citation: "A Global Measure of Perceived Stress."
Journal of Health and Social Behavior, *Vol. 24, No. 4 (Dec., 1983), Appendix A.*

Reprint to Appear In: *A Cross-Sectional Study: Dietary Micronutrient Levels in Allied Health and Nursing Students*
Author(s): Grisseel Cruz-Espaillat, M.D.,M.P.H.
Print order: Approximate list price: $ Media: Print

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Protecting Human Subject Research Participants 3/24/13 6:06 PM

Certificate of Completion

The National Institutes of Health (NIH) Office of Extramural Research certifies that **Grisseel Cruz-Espaillat** successfully completed the NIH Web-based training course Protecting Human Research Participants“.

Date of completion: 06/07/2012

Certification Number: 933446

file:///C:/Users/NathanOffice/Downloads/NIH%20Protecting%20Human%20Subject%20Research%20Participants.webarchive Page 1 of 1

Appendix I: Consent Form and Referral Letters

Informed Consent Form

You are invited to take part in a research study entitled, "A Cross-Sectional Study: Dietary Micronutrient Levels in Allied Health and Nursing Students". This study will explore the relationship between dietary food intake and Regular Daily Allowance (RDA) requirements, and the correlation of student nutrition levels with stress and income. First year Allied Health and Nursing student population have been invited to participate in this research study. The intention of this study is to provide valuable insights about the nature of the relationship between dietary intake and the RDA requirements of first year students.

The study is being conducted by Dr. Grisseel Cruz-Espaillat, MD, MPH, a doctoral student at Walden University. Given the teacher-student relationship, to minimize the risk of coercion or perceive coercion, only first year Allied Health and Nursing students will be invited to participant. No current or future students of Dr. Cruz-Espaillat will be allowed to participate in the study. This form is part of a process called "informed consent", to provide an understanding of the nature of the study before you decide whether to participate.

If you agree to participate in the study, please submit a signed consent form to researcher. Once the researcher has received all consent forms, students will be randomly selected, therefore not all interest students may be selected to participate in the study. Randomly selected students will receive a scheduled date, time, and location. If you are not able to keep your appointment and you are still interested in participating in the study, please contact Dr. Cruz-Espaillat for rescheduling. Rescheduling will be available during the 5 days of the research study. Please be aware that no further scheduling will be available once required sample size has been obtained and the study has been concluded. The study will consist of two phases. Phase I of the study will consist of demographic information, fruit & vegetable prescreening, and a perceived stress scale survey. The questions will center on your recollection of the daily dietary food intake and Recommended Daily Allowance (RDA) requirements, demographics, and stress related questions. Phase I of the study will take approximately 25 to 30 minutes. Phase II will include a Food Frequency Questionnaire (FFQ) survey. The FFQ will be a more thorough questionnaire to recollect your daily dietary food intake and RDA. The phase II of study will take approximately 45-50 minutes.

The inclusions/ exclusions and process of the study:

Inclusions for this research study include the following:

Phase I of "A Cross-Sectional Study: Dietary Micronutrient Levels in Allied Health and Nursing Students":

1. Read all of the contents of this consent form and if you agree, sign consent form and send to the researcher Walden's email
2. Complete Demographics form (paper format)
3. Complete Perceive Stress Scale survey (paper format)
4. Complete Fruit & Vegetable prescreen online survey.

Phase II of "A Cross-Sectional Study: Dietary Micronutrient Levels in Allied Health and Nursing Students":

1. Verification of signed consent form
2. Completed demographic form and Perceive Stress Scale survey from Phase I
3. Complete Fruit & Vegetable prescreen survey from Phase I with a score less than the required daily fruit & vegetable intake.
4. Complete Food Frequency Questionnaire survey.

Exclusions of the study include the following:

1. You are a current or will be a future student of Dr. Cruz-Espaillat.
2. Have not signed a consent form
3. Did not complete demographic form, perceive stress survey
4. In Phase I, if you scored more than the required daily fruit & vegetable intake in the Fruit & vegetable prescreen survey, you will not proceed to Phase II of the study.

Procedure Steps for Research Study:

On the day of your appointment, you will be asked to show your student university ID card. The student ID number on the card must match the student number that you wrote on the signed consent form. Once this has been verified, you will be asked to be seated in one of the cubicle's in Keiser University library to complete the paper forms and the electronic surveys. Each cubicle will have a computer where you will log in to the computer and have access to the online surveys in Phase I and Phase II of the study.

In Phase I, you will be asked to complete the demographic form and perceived stress survey that will be given in a paper format. Once you are finished with the paper forms, Dr. Cruz-Espaillat will collect the forms and place them in a folder that will be labeled with your student ID number. A copy of your signed consent form will be in the folder for verifications of consent. The entire folder will than be placed in a secured box and will only be handled by Dr. Cruz-Espaillat. In Phase I, you will also complete a fruit & vegetable prescreen survey online. If your scores are less than required amount of your daily fruit & vegetable intake, you will proceed to phase II of the study survey online. If your scores are within the recommended daily allowance you will not proceed to phase II of the study and your participation will be concluded. Students that meet the qualifications for Phase II data collection will be asked to log in to the food frequency questionnaire survey (NutritionQuest data-on-demand online system- Block 2005 FFQ ©). Dr. Cruz-Espaillat will instruct you on the use of the system and stand-by while the first two sample questions are answered to ensure that you can navigate the CASI system. Once this is confirmed, Dr. Cruz-Espaillat will allow you to complete the nutritional analysis survey independently. Once you have finished and submitted the questionnaire, your participation within the study is complete. No individual feedback will or can be provided to participants due to the anonymous and confidential nature of the study.

Voluntary Nature of the Study:

Your participation in this study is completely voluntary. If you decide not to participate in the study, it will not have an effect on your relationship with Keiser University or the researcher. During the study itself, if you decide that you do not wish to take any further part, then please inform Dr. Cruz-Espaillat and she will facilitate your withdrawal from the study. You do not need to give a reason for your withdrawal. Any personal information or data that you have provided (both paper and electronic) will be destroyed or deleted as soon as possible after your withdrawal.

Risk and Benefits of Being in the Study:

There are no personal risks associated with your participation in the study. However, there is a small risk that your name can be identified. All identifying information will be excluded for the case study write up. All information and data gathered will not be used for purposes outside of the study. All data collection will be stored and will be destroyed 5 years following the conclusion of the study. There are no immediate benefits to you in this study except to identify any severe nutritional deficiencies you may have. The overall benefits associated with this study are being able to demonstrate the probability of micronutrient deficiency in healthy individuals. In addition to assessing your dietary levels based on the RDA, a perceived stress scale survey will be used to measure your level of stress and associate these levels to your RDA levels. Outside of contributing your experiential knowledge to this research project, your only benefit for your time contribution to this study will be to leave with a better understanding of the importance of having adequate levels of micronutrients in your diet and be aware of your stress levels. This research will help you be aware of risk factors that are involved with inadequate levels of micronutrients and stress levels leading to chronic diseases such as cardiovascular diseases, diabetes, and cancer.

Payments:

There will be no type of payment, thank you gifts, or reimbursements provided for your participation. All students that would like a more thorough examination of their levels of micronutrients will be referred to South Miami Hospital Clinical Nutrition Services where they will have the option of making an appointment with a licensed dietitian. Students that are not covered by insurance will receive a special discount. All of your questions will be answered when you call for an appointment. For any additional concerns or assistance, all students will be referred to the statewide referral network social services for assistance (211 Referral Service Line).

Participant's Rights:

If you have read this form and have decided to participate in this project, please understand your participation is voluntary and you have the right to withdraw your consent or discontinue participation at any time without penalty. Your individual privacy will be maintained in all published and written data resulting from the study.

Contact Information

If you have any questions, you should contact the researcher, Grisseel Cruz-Espaillat, M.D., M.P.H. by email or by phone. If you want to talk privately about your rights as a participant, you can call the Walden University representative who can discuss this with you. Walden University's approval number for this study is 09-18-13-0141019 and it expires on September 17, 2014. The researcher will give you a copy of this form to keep.

Statement of Consent:

I have read the information above and I understand the study well enough to make a decision about my involvement. I fully understand my participation is voluntary and that I am free to withdraw from the research study at any time and at any stage, without giving any reason. By providing my electronic signature below and emailing this form back to Grisseel Cruz-Espaillat, M.D., M.P.H., I am agreeing to the terms described above.

Participants ID number: ____

Participants email address: ____

Date of consent: _____________________________

KEISER UNIVERSITY

Miami Campus
2101 N.W. 117th Avenue
Miami, Florda 33172

Invitation Letter

You are invited to take part in a research study titled “A Cross-Sectional Study: Dietary Micronutrient Levels in Allied Health and Nursing Students”. This study will explore the relationship between dietary food intake variables and Regular Daily Allowance (RDA) requirements, RDA comparison with stress and income levels.

The study is being conducted by Dr. Grisseel Cruz-Espaillat, M.D., M.P.H. a doctoral student at Walden University. It is important that you understand that this study is separate from her role as a faculty member at Keiser University and the study is not part of Keiser University.

Dr. Cruz-Espaillat has attached a consent form for your review. The consent form gives a more detailed explanation of the study. Once you have read the consent form and feel that you have additonal questions please contact Dr. Cruz-Espaillat. She will answer all questions or concerns that you may have about the study. If you would like to participate in the study, please forward your signed consent form to her attention at XXX.

Once Dr. Cruz-Espaillat recieves your signed consent form, she will be directly contacting you. Keiser University will not be contacting you, since this study is separate from the university. The intention of this letter is so that you are aware that Dr. Cruz-Espaillat has been given permissions to approach first year Allied Health and Nursing students and invite you to participate in the study.

Respectfully,

Dean of Academic Affairs Campus President

Location of the Study: Keiser University (Miami Campus)
2101 N.W. 117th Avenue
Miami, Florda 33172

Participation Notification

Thank you for kindly agreeing to be part of the research study titled "A Cross-Sectional Study: Dietary Micronutrient Levels in Allied Health and Nursing Students". The purpose of the study is to explore the relationship between dietary food intake variables and Regular Daily Allowance (RDA) requirements, RDA with stress and income levels. I would like to thank you for your valuable support.

Your are scheduled to be at Keiser University's library on XX/XX/XXXX, at X:XX am/pm. Please remember that the study consist of two phases. Phase I will consist of completion of demographic form, stress survey, and a fruit & vegetable prescreen survey online. Phase II of the study will depend on the score results of the fruit & vegetable prescreen. If your scores are less than required amount of your daily fruit & vegetable intake, you will proceed to phase II of the study survey online. If your scores are within the recommended daily allowance you will not proceed to phase II of the study and your participation will be concluded. Please bring your Keiser University's student ID card for identification verfication. If you are not able to keep your appointment and you are still interested in participating in the research study, please contact Dr. Cruz-Espaillat for rescheduling. Rescheduling will be available during the 5 day's of the implementation of the study. No further scheduling will be available once required sample size has been obtained and the intervention has been concluded.

I appreciate your time and participation. If you have any questions or concerns please do not hesitate in contacting me.

Respectfully,

Grisseel Cruz-Espaillat, M.D., M.P.H.

South Miami Hospital
BAPTIST HEALTH

6200 SW 73 Street
Miami, Florida 33143
Tel: 786-662-4000
www.baptisthealth.net

Grisseel Cruz- Espaillat, MD. M.P.H
Professor of Anatomy & Physiology
Obstetrics Gynecology/Embryology
Kaiser University (Miami Campus)
2101 NW 117 Avenue
Miami, FL 33172

April 18, 2013

Good Afternoon Dr.Cruz,

It was indeed a pleasure to talk to you today. The research project you are working on is very interesting and the goal really impresses me. I already mentioned it to some of my registered dietitians and we are all looking forward to meet you and to provide the nutritional counseling services to your students as needed.

I will send you the brochures (Spanish & English), for you to share with the students about our services and how to get in touch with the dietitian for nutrition counseling appointment.
The educational session includes a nutrition assessment and the instructions on the medical nutrition therapy needed by the student. Dietitian report of the intervention will be mailed to you as well, for your information.

As I explained over the phone, if the student is not covered by the insurance, special discount is provided if self-paid. All questions can be answered when the student call for the appointment.

Thank you for the interest in our outpatient nutrition services. And best wishes for success in your valuable research study.

Best,

Myrna Caniglia, RD, LD/N
Manager,
Clinical Nutrition Services
South Miami Hospital
(Phone) 786-662-8273

HEALTHY EATING STARTS HERE

With Help From Baptist Health

Healthy Eating. It Starts Here.

What you eat has a big impact on your health. Whether you are trying to reach a healthy weight, cope with an illness or reduce the risk of disease, proper nutrition plays an important role. Our program offers people of all ages and medical histories the support and guidance needed to make healthy food choices, one step at a time.

What We Offer

Baptist and South Miami Hospitals' registered and licensed dietitians offer personalized nutrition counseling designed to fit your healthcare needs. Our dietitians are knowledgeable in all areas of nutrition and can develop healthy eating plans based on the following health concerns:

- heart disease, including management of high blood pressure and high cholesterol
- cancer
- gastrointestinal disorders
- weight management
- bariatic surgery (South Miami Hospital only)
- kidney disease
- pregnancy
- healthy vegetarian eating
- nutrition for children and adolescents

Services are offered in English and Spanish.

A one-hour initial appointment includes an in-depth assessment to determine your nutritional needs. The dietitian will discuss ways to make healthy food choices, and you will receive information to help you understand and manage your nutritional needs. Thirty-minute follow-up appointments, if necessary, are available.

Payment is required at the time of the appointment. Your insurance company may reimburse you for nutrition counseling ordered by a physician. Check with your insurance company to be sure of your coverage.

Scheduling an Appointment

For more information or to schedule an appointment, call Outpatient Nutrition Services:

Baptist Hospital
8900 North Kendall Drive
786-596-7219

South Miami Hospital
6200 SW 73 Street
786-662-8331

Curriculum Vitae

Grisseel A. Cruz-Espaillat, MD., M.P.H.

Summary of Qualifications

Background encompasses a record of accomplishments in undergraduate and medical studies along with success in positions requiring scientific method, clinical research technique and interpersonal skill.

Areas of Expertise

- Experienced in the organization and administration of clinical trials. Rigorous in ensuring the integrity of research data while maintaining strict adherence to experimental protocol.
- Flexible, able to work effectively with individuals from widely varying ethnic, educational, and socioeconomic backgrounds.
- Women's Health, Health Promotion, Graduate and Undergraduate University Teaching.
- Anatomy & Physiology, Graduate and Undergraduate University Teaching.

Education

March 2009-Present	Ph.D in Public Health Epidemiology	Walden University
June 2000	Masters in Public Health Epidemiology	Florida International University/ University Of Miami Public Health Department
Sept.1982- April 1987	Medical Doctor, MD. Degree	Universidad Central del Este, San Pedro De Macoris, Dominican Republic.
1982	Associate of Arts Degree	Miami Dade Community College, North Campus. Miami, Florida
June 1992	Occupational Safety and Health Administration	Dade County Health Department –HRS

Feb. 1992	Florida Bicycle Program, Pedestrian Design Training Course	Department of Transportation / University of Miami
Sept.-Oct. 1991	Abdominal, Obstetrics Gynecology, and Prostate Diagnostic Ultrasound	Jefferson Medical College of Thomas Jefferson University, Thomas Jefferson University Hospital Philadelphia, Penn.
Jan. 1991- Feb. 1992	Associate of Specialized Technology as a Diagnostic Medical Sonographer	National School of Technology. Hialeah, Florida
Aug.-Sept. 1987	Cardiology Teaching Program Training in CPR and ACLS	University of Miami/ School of Medicine Miami, Florida

Professional Experience

October 2004- Current Keiser University Miami, FL

Medical Professor in Anatomy and Physiology/ Obstetrics Gynecology/Embryology

- Faculty instructor in Anatomy and Physiology/Obstetrics Gynecology/Embryology
- Prepare lecture, curriculum and exams
- Laboratory/Dissection of specimens
- Clinical Rotations

September 2000- July 2003 Miami Children Hospital Miami, FL

Preventive Medicine Department Health Educator

- Develop interventions, delivers education programs
- Works under the direct supervision of the Preventive Medicine Director.
- Develops consortia of Adolescent Pregnancy and Parenting networks and programs
- Develops consortia of District Juvenile Justice networks and programs
- Represents Miami Children Hospital at local and state Preventive Medicine meetings
- Promotes Adolescent Pregnancy and Parenting
- Promotes risk-behavior topics to the adolescent population and gives presentations,
- Develops grants and assist others in grant developing.

September 1998 – May 2000 St. Benedict Catholic Church Hialeah, FL
School Religion Professor

- Prepared students for the Holy Communion
- Lecture and presentations on bible scriptures, prayers, and understanding of religion.

November 1992 – November 2000 Dade County Health Department Miami, FL
Injury Prevention Coordinator/ Health Educator Consultant

- Supervises a Secretary Specialist and Environmental Specialist I.
- Works under the direct supervision of the Medical Director of Epidemiology and the State Injury Prevention Coordinator.
- Develops consortia of Injury Prevention networks and programs
- Develops interventions, delivers education programs
- Represents the County Public Health Department and State at Injury Prevention meetings
- Promotes Injury Prevention, gives presentations,
- Develops grants and assist others with grant development

April 1992 – September 1996 National School of Technology Hialeah, FL
Diagnostic Medical Sonographer Instructor

- Abdominal and Gynecology/Obstetrical Ultrasound Instructor
- Prepare lecture, curriculum and exams for each perspective course. Each course consist of an intensive medical level of Anatomy, physiology, Embryology, and Pathology
- Teach scanning techniques and give protocols for each anatomical organs and Fetal Development stage.
- Teach patient care and responsibility.
- Prepare student for the National Registration Certification (ARDMS)

August 1991 – November 1992 Dade County Health Department Miami, FL
HRS Injury Prevention Unit Injury Prevention Specialist

- Develop a County Consortia of initiatives for the promotion of Head and Spinal Cord Injuries Prevention efforts.
- Develop recommendations for and assist the Interagency Office of Disability Prevention in the formulation of policy, laws and product design to reduce the incident of head and spinal cord injuries.
- Identify and maintain a directory of County and local organizations involved in head and spinal cord injuries prevention.
- Arrange and conduct workshops, symposiums, conferences and other group meetings and presentations at the County and Municipal level on head and spinal cord injuries.
- Promote head and spinal cord injury public service announcements

- Work with schools, churches and civic organizations to educate and make the public aware of the causes, severity and economic impact of head and spinal injuries in the County and local enforcement
- Assist in the research and development of head and spinal cord injury prevention grant proposals
- Represent the County Public health at conferences and meetings related to head and spinal cord injuries research prevention and treatment.
- Identifies, receives and disseminates epidemiology data related to head and spinal injuries.

March 1989 – August 1991 HRS State of Florida Miami, FL

Environmental Health Specialist

- Inspect food outlet and food processing, up to 250 places
- Ensure customers safety and scientific integrity by effectively implementing establishment procedures
- Investigate any nuisance or bacteriological infections that can be transmitted to any human or to the community.

May – June 1988 UM/Jackson Memorial Hospital Miami, FL

Observer and Volunteer

- Rotation in Pediatrics with pediatric Residents
- Attended in the Pediatrics conferences.

Medical Internship

Internships were completed from 1986 to 1987

Obstetrics/Gynecology

Jaime Oliver Pino General Hospital, San Pedro de Macoris, Dominican Republic

Pediatrics

Materno Infantil, San Lorenzo Los Minas Children Hospital, Dominican Republic

Trauma/ Neurology/ Surgery

Dario Contrera Hospital, Santo Domingo, Dominican Republic.

Trauma/Neurology/ Surgery

Dr. Salvador B. Gautier Hospital, Santo Domingo, Dominican Republic

Internal Medicine

Padre Ballini Hospital, Santo Domingo, Dominican Republic.

Ph.D. Residency

Fall 2009 Jacksonville, Florida

Summer 2010 Madrid, Spain

Winter 2010 Miami, Florida

Fall 2012 Shanghai, China

Certifications

2012 National Institutes of Health (NIH) Office of Extramural Research (Certif. XXXXX)
2012 Registered Yoga Instructor with the Yoga alliance (Reg. XXXXX)
2011 Black Belt in Shito Ru (Dan 2)
2010 National Institutes of Health (NIH) Office of Extramural Research (Certif. XXXXX)
2007 Registered Yoga Instructor with the Yoga Alliance (Reg. XXXXX)
2006 BLS Instructor (Renewal until 12/2008)
2006 Healthcare Provider BLS (Renewal until 12/2008)
2006 Registered Yoga Instructor with the Yoga Alliance (Reg. XXXXX)
2006 American Red Cross CPR Instructor Reg. XXXXXXX (Renewal until 12/31/2008
2006 Black Belt in Shito Ru (Dan 1)
2006 Kinesthetic Anatomy CoreData / Zahourek System
2005 Registered Yoga Instructor with the Yoga Alliance (Reg. XXXXX)
2005 Certified Professional Bellydance
2005 Black Belt in Shito Ru
2004 American Red Cross CPR Instructor (Renewal until 12/31/06)
2004 Registered Yoga Instructor with the Yoga Alliance (Reg. XXXXX)
2004 Certified Yoga Instructor
2004 Registered Medical Assistant (Reg. XXXXX)
2003 American Red Cross CPR Instructor (Renewal until 12/31/04)
2003 Child Passenger Safety Technician Instructor-I0123
2002 Registered Karuna Reiki Master (Reg. XXXXX)
2002 American Red Cross CPR Instructor
2002 Safe Sitter Instructor
2001 HIV/ AIDS TPED with CME
2001 American Red Cross CPR Instructor
2001 Child Passenger Safety Technician Instructor- XXXXX
2000 Child Passenger Safety Technician Instructor- XXXXX
1999 Domestic Violence Certification with CME
1999 HIV Certification with CME

1999 Child Passenger Safety Technician Instructor - XXXXX
1999 Recertified CPR
1993 Certification on Stage 1 Handling Student Conflicts: A Positive Approach, Peace Education Foundation
1995 Certification on Special Firesafety Inspector, Miami Dade Community College
1995 Certification on Lead Risk Assessment, University of Florida Center for Training, Research and Education for Environmental Occupation- XX-XXX
1995 Certification on Lead Inspector, University of Florida Center for training, Research and Education for Environmental Occupation – XX-XXX
1995 Certification for Respect Life Training from the Respect Life Apostolate Archdiocese of Miami
1987 ACLS: Advanced Cardiac Life Support

Licenses

Medical Licenses:

- Dominican Republic **-** XX.XX-XX
- Florida - XXXX(Registry of Diagnostic Medical Sonographers)

Research

September 1986 – September 1987
Study of Placenta Previa. Centro Medico Rural, Cayetano Germosen, Moca, Dominican Republic.

1991: Collaborated in the *Research of Digitized Mapping of Fatal and Nonfatal Injury in Dade County Florida: An Investigation into the Spatial Distribution of Injury.* Dade County Department of Health, Metro-Dade Fire Department Data Systems, Dade County Medical Examiner's Office
Granted by State Office of Emergency Medical Services / Institute for Health and Human Services Research in Tallahassee.

February 1992 – September 1994
Longitudinal Evaluation of the Dade County Implementation of the Think First Head and Spinal Cord Injury Prevention Program. Dade County Department of Health, Miami, Florida.
Granted by the Office of Emergency Medical Services

June – October 1992.
Motor Vehicle Crash Intervention on Child Safety Seats. Dade County Department of Health, Miami, Florida. Granted by the Office of Emergency Medical Services

1992-93 / 1993-94.
Conflict Resolution, Violence Prevention Intervention Project. Dade County Department of Health / Dade County School Board, Miami, Florida. Granted by the Centers of Disease Control.

1998-1999
Dade County Safety Seat Program. Dade County Department of Health, Miami, Florida. Granted by Florida Department of Transportation.

1998-1999
Dade County Hispanic Safety Seat Program. Dade County Department of Health, Miami, Florida.
Granted by Florida Department of Transportation.

September 1999-2000.
Dade County Hispanic Safety Seat Program. Dade County Department of Health, Miami, Florida.
Granted by Florida Department of Transportation.

Sept. 2000-2001
Baby So Soon Program. Miami Children's Hospital, Miami, Florida. Phase I granted by CATCH American Pediatrics Association. Phase II and III granted by the March of Dimes.

Sept.2001-2002
Frequencies and Distributions of Pre and Post Tests and MCH Youth Risk Behavior Survey. Miami Children's Hospital, Miami, Florida. Granted by Department of Juvenile Justice.

Sept. 2000-2003
Adolescent Pregnancy, Parenting, and Prevention Council. Miami Children's Hospital, Miami, Florida. Granted by United Way
September 2000-2003*Health Educator for Health on Wheels (Youth Correctional Institutes)* Miami Children's Hospital, Miami, Florida. Granted by Department of Juvenile Justice.

May 2006- 2009
Anatomy in Clay Educational Implementation of Muscle/Skeletal Origin and Insertion Pre and Post Test Survey. Keiser College Kendall Campus, Miami Florida. Granted **by** Anatomy In Clay™ From Zahourek Systems

Professional Accomplishments

Articles

September 1993 — Tampa, Florida.
Florida School Health and Full Service Schools: HRS & DOE Joint Conference 1993 Institute for At-Risk Infants, Children & Youth and Their Families. College of Education University of South Florida. Page 83-86.
Topic: Prevention of Violence: Are You Part of the Solution.

Winter 1994 — Miami, Florida.
Miami Children's Hospital Prevention Medicine News Volume I, Numbers 3& 4.
Topic: Injury and Violence Prevention in Schools: Are You part of the Solution?

Winter 1994 — Miami, Florida
Images: Bascom palmer Eye Institute
Volume XVII: Issue I -Winter 1994. Page 6-7.
Topic: Sjögren's Syndrome.

December 2005 — Miami, Florida
Kobushi Karate
Topic: The Anatomy Used In Karate

April 2010 — Miami, Florida
Journal of Career Education Principles and Practices
http://www.keiseruniversity.edu/jcepp/
Vol. 1, No. 1 (April 2010)
Anatomy in Clay Testing

Media

August 12, 2002 — Miami, Florida
Media Outlet: Telemundo Network "de Mañanita"
Title of Clipping: First-Aid Series: CPR-Near Drowning.

July 12, 2002 — Miami, Florida
Media Outlet: Telemundo Network "de Mañanita"
Title of Clipping: Girls and puberty.

July 3, 2002 — Miami, Florida
Media Outlet: Telefutura " Escandalo del medio dia"
Title of Clipping: Good Posture

May 22, 2002 — Miami, Florida

Media Outlet: WPLG 10
Title of Clipping: Summer of Safety

Awards and Honors

1993 Plaque Award from the Metro-Dade Fire Department in appreciation for contribution to Dade County Youth Fair Safety Village.
1994 Certificate of Appreciation Think First Miami, Head and Spinal Cord Injury Prevention Program from Jackson Memorial Medical Center/ University of Miami Department of Neurological Surgery
1995 Certificate of Dedication and commitment Award from the State of Florida Department of Health & Rehabilitative Services
1995 Plaque Award from the National Police of Ecuador International Relations in Injury Prevention (Intentional/ Unintentional)
1996 Certificate of Appreciation from the State of Florida Department of Health & Rehabilitative Services
1996 Plaque Award from the Dade County Public Health Unit Employee of the Month
1997 Certificate of Appreciation from the State of Florida Department of Health & Rehabilitative Services
1997 Certificate of Special Recognition from the University of Miami/ Jackson Memorial Hospital Burn Center
1997 Letter of Appreciation from the Pan American Health Network-Wellness Service From Pan American Hospital
1997 Certificate of Appreciation from University of Miami/Jackson Memorial Medical Center Trauma Prevention
1998 Certificate of Appreciation for the Annual Florida Youth Leadership Conference On Health from the Miami Children Hospital Department of Preventive Medicine
1998 Certificate of Appreciation from University of Miami/Jackson Memorial Medical Center, Trauma Prevention
1999 Certificate of Appreciation from University of Miami/ Jackson Memorial Medical Center, Trauma Prevention
1999 Trophy Award of Appreciation from Miami Children Hospital Preventive Medicine Department Youth Conference
2001 Proclamation from the Camara de Representates de Puerto Rico award for Appreciation in training 25 firefighters from Puerto Rico on Child Passenger Safety which was awarded by the State Secretary of Puerto Rico.
2001 Merit Pin and Embroidered Firefighter of Puerto Rico Patch (this is awarded only to those that have gone beyond their duties for the health and safety of the community).
2001 Recognition from the Daughter of the First Lady of Puerto Rico for training Puerto Rican firefighters.
2007 Evelyn C. Keiser Teaching Excellence Award – Instructor of Distinction
2008 Evelyn C. Keiser Teaching Excellence Award – Instructor of Distinction
2010 Evelyn C. Keiser Teaching Excellence Award – Instructor of Distinction

Continued Medical Education

1993	Injury Prevention: Delivery, Education, Research by the College of Public Health, University of South Florida, Tampa Campus
1993	Pediatric Postgraduate Course sponsored by Miami Children's Hospital
1995	Pediatric Postgraduate Course sponsored by Miami Children Hospital
1995	Pediatric Postgraduate Mini-Course on Emergency Medicine and Dermatology Symposium & Live patient Workshop sponsored by Miami Children Hospital
1996	Postgraduate Course sponsored by Miami Children Hospital
1997	Pediatric Postgraduate Course sponsored by Miami Children Hospital
1997	Youth and Violence, Treatment and Prevention: A Miami Perspective sponsored By Baptist Hospital
1998	Pediatric Postgraduate Course sponsored by Miami Children Hospital
1999	HIV –AIDS by Nova Southeastern University
1999	Domestic and Child Abuse by Nova Southeastern University
1999	Prescription Privilege by Nova Southeastern University
1999	Comprehensive Five Day Medical Review by Nova Southeastern University
1999	Integrated Management to Childhood Illnesses/Atencion Integrada a las Enfermedades Prevalentes De La Infancia (AIEPI)
2001	Medical Review Course by Comprehensive Medical Education, Inc.
2001	Curso Regional de Seguimiento Posterior A La Capacitacion Sobre Atencion Integrada A Las Enfermedades Prevalentes De La Infancia (AIEPI)" en Santa Fe, Argentina, por el Insstituto Nacional de Enfermedades Respiratorias "Dr. Emilio Coni" y la Organizacion Panamericana de la Salud.
2003	Postgraduate Course sponsored by Miami Children's Hospital
2006	Kinesthetic Anatomy CoreData /Zahourek System

Membership in Professional Organizations

1987- Present	Asociacion Medica Dominicana (AMD)
1993- Present	Sonography Society of South Florida
1991- 2000	Dade County Injury Prevention Coalition
1995-2001	Safe Kids Coalition
1996-2000	Hispanic of Aging
1999-2001	Multicultural Minority Task Forces
2000-2003	Adolescent Pregnancy, Parenting and Prevention Council (Chairperson)
2001-2004	March of Dimes Dade-Monroe Committee (Chairperson)
2004-2006	March of Dimes Dade-Monroe Committee
2004-Present	Yoga Alliance
2005-Present	Yoga Research Society
2005-Present	The Human Anatomy and Physiology Society
2005- Present	American Association Anatomists