

Impact of the American Diet on Newly-Arrived International Students during their first three months at Virginia Tech

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HUMAN NUTRITION, FOODS AND EXERCISE

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Abstract

Rationale: Published studies have shown that immigrants undergo dietary acculturation which may have positive or negative impact on their health. Therefore, a study was conducted to investigate this critical issue of dietary acculturation and any possible influence on the health status of newly arrived international students at Virginia Tech in Fall 2010.

Design: In this study weight, fasting blood glucose and blood pressure of 35 international students (age 18-36 years) were determined at three time points, 5-6 weeks apart. Participants filled out a 20-item-questionnaire addressing alteration in the native and American dietary habits. Furthermore, 24 hrs dietary recalls and frequency of consuming the most popular food items in the US was assessed.

Results: Total sample population (TSP) had a significant increase in average weight by 2.79 lbs from visit 1 (V1) to visit 3 (V3) ($p=0.0082$), Participants who gained weight (PGW; $n=10$) had an average increase by 9 lbs. Country wise, Chinese had a statistically significant average increase in their weights by 4.16 lbs ($p=0.0077$) whereas, Indians and Germans had an average increase by 2.36 lbs and 1.28 lbs respectively. Gender wise, the average increase in weight for females was 3.99 lbs ($p=0.0015$) while for males 1.52 lbs from V1 to V3. There were no significant differences in total caloric consumption from V1 to V3 for both groups of international students. There were no significant changes in the fasting blood glucose and systolic blood pressure from V1 to V3. There was an increase in frequency of consuming high calorie American food items in V3 when compared with V1. Frequency of burger consumption was highly increased in the TSP group while bagels were significantly increased in PGW group. There was an overall increasing trend towards American diet, cooking and eating habits.

Finally, we conclude that the international students are gradually acculturating to the American diet and have impact on their weight which may potentially have a negative impact on their health status. Future studies and orientation program catered to the needs of adjusting to acculturation process of international students are recommended.

Dedication

This thesis is dedicated to my father, Sami, who supported me in all possible ways, and has been a continuous source of encouragement and inspiration to me throughout my life.

To my mother, Batool, who dedicated her life to enrich me and my siblings with faith and belief that tomorrow, is better and greater.

I thank my parents for loving me, believing in me, and teaching me that I should never surrender because there is always a sunrise after every dark night.

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Chapter 1. Introduction

1.1 Introduction

American society is referred as a “salad bowl” for many ethnicities that have migrated from different countries and have integrated together creating a harmonious society. This country has a mix of various races that learn from and add to each other and make this country one of the most attractive places to reside. The combinations of ethnicities enrich the American culture not only with colorful traditions and beliefs but also with a diet that plays a major part in this natural blend. These contributions create what is known today as the American diet which cannot be portrayed easily as it is unique. According to previous studies in last two generations American and Immigrants had a dramatic change in their diet and life style (Taylor, Keim et al. 2006).

The standard American diet consists of (i) large intake of high-energy processed products in form of saturated fats and simple carbohydrates, and (ii) low intake of complex carbohydrates, fiber which are abundant in fruits, vegetables and whole grains. In a typical day, Americans consume three standard meals accompanied by multiple in-between meals snacks. Currently, the majority of young Americans rely on fast food as a big part of their diet. According to research, the consumption of fast food and sweetened beverages has increased among young adults, thus consumption of fruits and vegetables, as well as dairy products has decreased (Deshmukh-Taskar, Nicklas et al. 2007).

During the last few decades, changes in behavior patterns, for example, diet, smoking, alcohol consumption, and lack of physical activity have greatly affected the health status of individuals. It can be characterized by an increased prevalence of obesity, type II diabetes, metabolic syndrome, cardiovascular diseases and some type of cancers (Satia-Abouta 2003; Taylor, Keim et al. 2006; Deshmukh-Taskar, Nicklas et al. 2007). Furthermore, obesity is a rapidly growing problem in the United States, and is considered to have reached an epidemic rate within last twenty years (Miller 2005; Lee 2008). According to recent estimates in the U. S, the prevalence of obesity is 31.1% for men and 33.2% for women. Based on other sources, over 65% of adults are considered as either overweight or obese; thus having an increased risk for chronic diseases (Miller 2005; McCracken, Jiles et al. 2007). The increase in the prevalence of obesity is even

more distressing as it occurs in younger individuals - in their teens and 20s (Sparling 2007). Obesity is a result of high energy intake and minimum energy expenditure which is encouraged by the surrounding environment.

Not only the Native American college students are gaining weight but also the international immigrant students are facing this epidemiological challenge of a gain in weight and body fat after arriving on campus. As a natural transition of living in the US, international students are more prone to gain weight due to unavoidable changes in their food patterns associated with altered environment and life style. International students adapt to the “Western” dietary practices which are frequent snacking, eating out in restaurants, and consuming larger portions that are high in fats, carbohydrates and low in Fiber. There is a parallel increase in consumption of sweet beverages providing more calories than needed which potentially contributes to a chronic disease risk (Satia-Abouta 2003; Bowman and Vinyard 2004; Miller 2005; Lee 2008). Changes in eating habits greatly enhance the risk for cardiovascular disease and it is possible that the immigrants may experience greater risk of cardiovascular disease than their counterparts in the native country.

However, the process of adapting to the new environment and adjusting to different dietary habits present in the recently immigrated country which is known as dietary acculturation, has only recently received researchers’ attention (Satia-Abouta 2003). Numbers of international students enrolled in the U.S. universities are increasing every year. During their adaptation process they face multiple problems related to language, accommodation, financial stress, discrimination, and dietary restrictions that may cause anxiety, stress, sleeping disorders, confusion, and even depression (Lin 1997). This depression might result in many eating disorders which can result in weight gain.

1.2 Problem Statement

International students who move to the United States seeking higher education face many challenges e.g. adjustment to the new environment. Furthermore there are some other factors that make it difficult for them to adjust to the new environment including psycho-social stressors such as academic demands, lack of familiarity with the US culture, and changes in their social

circle that might lead to social isolation among international students. The students may also face some other barriers that lead to the lack of confidence such as language which makes it harder for them to communicate with the English speakers. Accents of the instructors, new learning systems and in some cases different informal practices are some new aspects that might require time for international students to become accustomed. The pressure to meet their family's expectation is another factor to keep in mind for international students as it increases their stress level. The consequences of the anxiety to excel academically might lead to sleep and eating disorders, fatigue, stomach ailments and headache (Lin 1997).

Another key important aspect is adjustment to new culinary practices. Students undergo a lot of environmental changes and live in new surroundings. Therefore, they might want to keep the same warmth of their native food to fall back on. The idea of maintaining a native diet might be hard to accomplish due to limited accessibility of ethnic foods. Most international students have different living arrangements before migrating to the US as they might be dependent on their families to prepare meals. However, the situation becomes different when the student migrates and has to prepare his own meals independently. The lack of experience in cooking and unfamiliarity with the terms/names of native food items makes it difficult for them to find and prepare certain native meals. Moreover, the variety of different ingredients may confuse some of the international students while choosing the one that is the closest to their native ingredient e.g. the peppers which are available in different forms and colors; jalapeno peppers, banana peppers, Anaheim pepper and habanera pepper. Some ingredients might confuse them due to their shape and names for example sweet potatoes and yams. International students have to pay higher prices to purchase their ethnic food and still the quality is not comparable to the quality of their native food. These confusions and difficulties obligate the international students to experiment with the food until they find the closest alternative which might lead towards wasting food and money.

International students due to financial load and lack of time may develop a preference toward consuming American fast food which might have an impact on their well being. Many of these international students change their eating habits to a higher carbohydrate and fat diet along with decreased consumption of fruits and vegetables. The portion size is another aspect that international students have to be introduced to.

Significance: The overall goal of this research is to observe acculturation process of international students at Virginia Tech. One goal of this instrument is to focus on the acculturation process and food choices and how they impact the well-being of the international group. The second goal of the instrument would help newly arrived students in the process of adjusting and familiarizing to a new cuisine and life pattern relating to food issues.

We were able to accomplish some of these goals after collecting the data and having detailed information about the dietary patterns of international students. Furthermore, we believe that there is a need to create some programs to assess, observe and serve the needs of the internationals. The hypothesis is related to the first goal as it assessed the diet of international students. This study will help the international students to realize what changes to expect and how to deal with them in best possible manner. This study's strength is the various dependant variables that are used to assess the changes that international students might undergo.

In this study, we observed the recently immigrated students who are residing in the U.S without their family. International students enrolled at Virginia Tech to study their dietary patterns and health status after arriving in the U.S. We assessed changes in their dietary habits, evaluated their acculturation to the American diet, and degree of their commitment to their native diet by sconducting a self administered survey. Furthermore, we determined any possible negative or positive changes in weight indicated by blood pressure and fast blood glucose levels. This research is designed to address the key question of dietary acculturation at 3 different time periods: (i) First period was the baseline- time when the students first arrived on campus for orientation (visit 1 = V1) (ii) Second period was in the middle of semester (visit 2 = V2); and (iii) Third period was around the end of semester (visit 3 = V3). The timeline for data collection was 11 weeks, and additional two weeks for analysis. In this research we found that there was a significant overall change in weight which might suggest that the change in weight is possibly due to increased inclination of the international students towards the American diet.

Chapter 2. Literature Review

2.1 American Dietary Habits

The United States represents a “multiethnic” culture and is home for many people who have immigrated from all over the world (Satia-Abouta, Patterson et al. 2002). Adapting to the local culture, immigrants also bring a rich cultural heritage to the US along with varied customs, beliefs, and values.

Results from a cross-sectional study showed that dietary habits varied due to different factors such as socioeconomic, demographic, behavioral, lifestyle and physical activity (Deshmukh-Taskar, Nicklas et al. 2007). Thus, American diet cannot be portrayed easily since it is difficult to be traced to the American diet back to one particular route/origin. The last two generations of Americans and immigrants have dramatically changed their life style and diet (Taylor, Keim et al. 2006).

Snacking, eating-out, consuming high fat, high-energy products and low intake of fruits, vegetables and whole grains characterize the current eating habits. Based on the literature review of nutrition patterns among young adults in general, and students in particular, the diet of young adults in U.S. can be characterized as: i) rich in fats, sugars and simple carbohydrates with a low intake of fruits, vegetables, soluble and insoluble fiber, complex carbohydrates, calcium-rich foods accompanied with an increased consumption of sweetened beverages; (ii) frequent snacking and eating-out habits; and (iii) choosing larger portions (Miller 2005; Neumark-Sztainer 2005; Taylor, Keim et al. 2006; McCracken, Jiles et al. 2007; Sparling 2007; Lee 2008) (Steenhuis and Vermeer 2009).

In a study performed by Taylor et al. (2006), a list of the most commonly consumed food items based on 5-threshold was created and a 4 day study was conducted on two groups of native American women of Oklahoma. A sample of 74 women were asked to provide a 1-day food list while another group of 71 women were asked to report a 4- day weighed food record. After providing participants with a list of diverse food items, it was found that table fats, white bread, coffee, and tea and sodas were the most commonly consumed foods. Interestingly, several

participants considered baked/boiled/mashed potato, jelly/jam as high-fat food items. The limitation of this study was that all the participants were women; therefore, the data cannot be generalized for all Americans. However, the report list of food items may show a trend (Taylor, Keim et al. 2006). A study showed that the total intake of fat increased from 1989-1995 and that the fried potato contributes as a major calorie source in a high-fat diet (Kennedy, Bowman et al. 1999).

Another distinctive characteristic of American diet are the portions. It has been observed that the portion size in the U.S. is larger when compared to Europe. The increase in portion size has been observed during the last couple of decades, especially in the consumption of high-energy solid products eaten in both the home and outside (Steenhuis and Vermeer 2009). Portions at market place are also two to three times bigger than recommended by federal agencies. The decision of choosing “more value and less money products” leads to purchasing big sized items. This choice also results in “portion distortion”, as a consumer perceives that the larger portions are appropriate to consume in one sitting and therefore, it becomes an acceptable standard. Portion distortion also implies an inability of individuals to understand and calculate the needed amount of food. Consumer would select to purchase food items keeping in mind the concept of saving money and obtaining larger portions which may result in passive over-consumption. Thus, people unintentionally consume meals that are rich in high-energy foods (Steenhuis and Vermeer 2009).

Dining-out is one of the important aspects of today’s modern and industrialized society, and U.S. adults spend nearly half of their food related expenses on dining out (Blisard 2002). The dietary habits of young college students are influenced by what they are exposed to during the early years of life particularly in the high school years. A study was performed to investigate association between lunch patterns, vending machine purchases and schools’ eating policy for 1088 randomly-selected students from 20 different high schools. The participants were asked to fill in a survey questionnaire about their lunch habits and purchases from a vending machine. The results of the study indicated that school policy did affect the food choices of students. The students from schools with an open campus policy were more inclined to eat lunch at a fast food restaurant when compared to schools with closed campus policy during lunch time (0.7 days/week vs. 0.2 days/week, respectively). There was a significant decrease in the snack-food

purchases from vending machines in schools with a policy than those without a policy. This mandatory school policy decreased the access to high-fat and sugar food items and helped students to have better/improved choices. Authors found that school policies influenced lunch patterns: the existing policy regarding type of food that can be sold by vending machines, or closed campus rule during lunch resulted in smaller amount of lunch bought from fast food restaurants and fewer snacks bought from vending machines; restrictions in operation time of soft drink vending machines positively resulted in reduced number of purchases of soft drinks from vending machines (Neumark-Sztainer 2005).

Obesity continues to be a critical issue as a national cross-sectional survey from 1960-2000 which documented that there was a significant increase in obesity (Kuczmarski, Flegal et al. 1994). The awareness of importance of healthy food in daily life and link between diet and health is growing in different developed countries. A study was conducted in 4 heterogeneous populations, American, Japanese, French, and Flemish to evaluate the attitude towards food, its role in their lives, worry about food, consumption of assumed healthier foods. Furthermore, the researchers addressed the association of foods with either nutritional or culinary contexts (Rozin, Fischler et al. 1999).

College students and a range of adults in different countries filled out a questionnaire. The American group had the highest scores for fat/salt reduced diet, they also reported their worries and concerns about the food items, yet they scored the least for perceiving that they were healthy eaters. Females also had higher scores for a healthy fat/salt reduced diet, concern and worry when compared to males. Furthermore, this study indicates one of the largest differences between the scores of males and females across countries as 84% American females reported consumption of fat/salt reduced diet at least a few times a week as compared to 17% Belgians male and 22% French males. Japanese and French groups had the lowest scores regarding worry. However, Japanese group had more culinary association with their native food as they associated food items with their traditional counterparts and meals. For example, there is an association between pasta and sauce, bread and butter, fried eggs and breakfast. Japanese did not have a nutritional association in regards to food items for example; there is no direct association between pasta and carbohydrate or fried egg with cholesterol. Americans had a lower culinary association in comparison to the Japanese. In terms of pleasure and importance of food in life,

French group scored the highest (Rozin, Fischler et al. 1999). These results indicate that Americans are more concerned about their diet and are more aware of health but consider themselves as unhealthy eaters. This study concludes that cross-cultural differences in the nutritional patterns affect the health status of heterogeneous populations.

2.2 Dietary habits among the young adults

Current research shows that snacking, consuming high-energy foods (high fat, sugar, soft drinks), and eating-out is a common dietary pattern for young adults. This is accompanied by either a lack or an absence of physical activity which increases the susceptibility for health-risks and negative behavioural patterns. These health issues are strongly associated with the development of obesity and related diseases, such as cardiac diseases, osteoporosis, and cancer (Neumark-Sztainer 2005; McCracken, Jiles et al. 2007; Lee 2008). It has been reported recently, that the nutritional habits of the adolescents and college students are not consistent with national recommendations (Neumark-Sztainer 2005).

A large-scale population-based study explored the health-risk behaviours of young adults aged 18-24 years in relation to their BMI. The study showed that 78.4% of participants consumed less than five fruits and vegetables per day, 43.2% performed inadequate or no physical activity, 28.9% were smoking, 11.9% experienced mental distress; 26.1% of respondents were overweight, and 13.6% were obese (McCracken, Jiles et al. 2007).

Beverage preference and consumption were studied among college students at Northeastern State University. A survey was used to collect data. The majority of respondents were under 21 yrs of age (65%), females (66.4%) and of Caucasian origin (63.1%). The data revealed that water was chosen as a preferred drink by 33% of students while soft drinks were favoured by 31.4% of participants. Respondents consuming soft drinks indicated that on an average they drink about 20 oz/day, which is equivalent to 57 gallons/yr. Interestingly, the amount of soft drinks consumed by the college students was above the previously reported per capita consumption by Americans in 2000, which was 53 gallons/yr (Miller 2005).

Brunt and Rhee (2005) studied the differences in eating patterns between normal weight and overweight college students based on their BMI. Data were collected from 256 students who

completed 42-item Diet Variety Questionnaire identifying products that they consumed during the previous three days. Respondents were between 18 and 56 years old. Approximately 35% were overweight with a BMI 25-30 kg/m², 10% were obese with a BMI 30 kg/m², and 6.5% were underweight with a BMI 19kg/m². Their dietary patterns differed based on BMI: overweight students more frequently consumed meal replacement beverages, citrus fruit, fish and beef and regular carbonated beverages. The subjects with BMI <25 kg/m² consumed fruits like peaches, apples and pears but not melon or berries. However, there were no significant differences in the consumption of dairy products, grains, vegetables, alcohol or sweet/salty snacks (Brunt 2005).

In another study conducted by the same researchers in 2006, 519 students completed a similar questionnaire as mentioned above and the participants were grouped on the basis of their living arrangements (off-campus; on-campus; living with parents). The mean age of the students was 21.1 years ranging from 18-56 years. Our study included graduates and undergraduate students who were living in three different settings i.e. on campus, off campus and with their parents. Students who were living off-campus were older than others living with their parents and on-campus. The data revealed that the on-campus students had a lower BMI (<19 kg/m²) when compared to off-campus students who were overweight (BMI>25 kg/m²). Overall students who were living off campus were eating more salty snacks, alcohol and fats/oils and less milk desserts, tomatoes, melon and other grains when compared to students living on-campus. There were no significant differences in the variety of meat, meat alternatives, or snacks between the three groups (Rhee.Y.S. 2006).

Results from a more recent study by Brunt and Rhee in 2008 which involved 585 subjects also had similar findings. Off-campus students were more overweight (BMI >25 kg/m²) (31%), whereas 16.4% of those on-campus were overweight. Dietary differences showed that off-campus students were less likely to consume milk desserts (P = .017), green leafy vegetables (P = .044), fruit juice (P = .043), and white bread (P = .041), but were more likely to consume alcohol (P = .0027). In conclusion, the off-campus students appear to have poor dietary habits when compared to on-campus students and those living with parents. This implies that the living arrangements have an impact on dietary habits. Although, the health educators generally focus on nutrition status of on-campus students, the result from the study show that on campus students

have a better dietary habits when compared to off –campus students. Collectively, these studies suggest that off-campus students should be advised to improve their dietary and lifestyle behaviors in order to prevent adverse affects on health (Brunt and Rhee 2008).

A health and food habits related study was conducted on young adults (n=1338) from 9 different states, categorized into 3 main groups: college students, college graduates and nonstudents. A questionnaire was designed and mailed to the subjects to assess their attitudes, behavior and food consumption patterns. The following table shows the average number of servings of food consumed/week among young adult women and young adult males. The differences in food choices between students, graduates and non-students were determined by Kruskal-Wallis analysis of variance and the Kolmogrov-Smirnov two-sample test was used for comparison of means for each student group.

From this study, results indicated that the non-students were more prone to chronic illnesses due to unhealthy eating habits. From the survey it was concluded that the college students and graduates had healthier dietary patterns, followed the recommendations of the Food Guide pyramid (Cited in The food guide pyramid, 1992) and were smoking less when compared to the nonstudents. Additionally, female nonstudents were observed to be overweight when compared to other female counterparts. The nonstudents preferred higher-fat milk and meats and ate more French fries while college students and graduates ate more grain foods, fruits, dark green vegetables and chose low fat milk and meats (Constance and K. Peters. 1997). In terms of eating habits, a report showed that female students consumed less calories, dietary fiber, calcium, iron, zinc, potassium and polyunsaturated fats. Interestingly, male students consumed more than the recommended daily allowance of fat, saturated fat, cholesterol, and sodium. (Galore 1993).

Comparison of dietary pattern of young adults reveals that the eating habits appear to be unhealthy in the US compared to some other countries. For example, a study was performed on college student in Lebanese American University (in Beirut) to determine the prevalence of overweight and obesity and to examine their dietary habits. A cross-section survey of 220 students during the Fall 2006 was conducted and BMI was used to assess students' weight status.

The majority of the Lebanese students (64.7%) had normal weight and were consuming colored vegetables and fruits. Female students showed healthier eating pattern in terms of breakfast consumption when compared to males. Moreover, a significant difference was observed in the meal frequency between genders ($p=0.001$) that is indicated in p-values mentioned above. In addition, the alcohol intake and smoking were not common among the students (Yahia, Achkar et al. 2008).

2.3 Dietary Acculturation

After migrating to the U.S, international students experience acculturation which is a process of adapting and accepting local behavioural and cultural patterns of the host country. Acculturation also includes alteration in their social, psychological, economical and political beliefs (Berry 1997). Recently arrived students have varied reactions towards their host country and culture. Some of them quickly embrace the new culture, while others may experience difficulties in adjusting. Moreover, strong attachment to their native culture and traditions may result in negative feelings and delay their process of acculturation. This attitude is due to difficulties in communication skills because of the language barrier, alienation, perceived discrimination, and homesickness. Thus, international students mingle and have relationships with people who have the same ethnicity. Students from individualistic cultures may adapt well with the U.S mainstream culture, while those from more collectivist cultures have less likelihood to become accustomed to the American lifestyle (Day 1986; Swagler 2003; Poyrazli and Lopez 2007).

Non-European international students (Asian, Central/South American and African) face more acculturative stress when compared to European students because of factors that include, differences in lifestyle and culture, increased stress due to loneliness, lowered self-esteem, depression and sleep disorders, anxiety, or other mental health problems (Constantine and Kwan 2003). They may be encouraged to go into relationships with other international group but not the groups from the host country (Poyrazli and Lopez 2007).

The process of acculturation is usually stressful for international students. Education about differences and commonalities of two countries may be helpful. Special programs are recommended in order to help international students undergo a relatively easier adjustment

process to decrease the stress and be competent in studies (Lin 1997). Dietary acculturation can be described as the process during which immigrants and their family members adopt the dietary practices of the host country. Data from dietary acculturation assessment can also give information about general acculturation (Satia-Abouta, Patterson et al. 2002; Satia-Abouta 2003; Pierce, Austin et al. 2007; Lee 2008).

The dietary intake of immigrants is influenced by socio-demographic and cultural factors, exposure to host culture, and environmental factors and diet-related psychosocial issues. Collectively, these factors create 3 main dietary categories (i) immigrants may continue practicing their traditional dietary models; (ii) entirely adopt dietary behavior and food of host country; (iii) include several eating patterns of host country and maintain their traditional dietary models (Satia-Abouta, Patterson et al. 2002). Dietary acculturation may result in either healthy or unhealthy changes in nutritional habits. For instance, the Hispanics residing in the US for longer periods had micronutrient profiles similar to the non-Hispanic whites. Hispanic immigrants' preference for soda instead of traditional juices is a negative impact of acculturation, while switching to less saturated fat is a positive change (Bermudez, Falcon et al. 2000; Satia-Abouta, Patterson et al. 2002). Therefore, the changes in dietary habits are not always detrimental.

Reports about the process of dietary acculturation among Latinos, Korean Americans and Japanese American showed that there are changes in their dietary habits which favor an increased risk for obesity (Perez-Escamilla and Putnik 2007; Pierce, Austin et al. 2007; Lee 2008). Korean immigrants are likely to change their habits slowly. A study was conducted to assess the dietary habits of Korean American in relation to their meal frequency, snacking, and eating-out. The participants were young adults (≥ 17 years), who were randomly sampled from a telephone book and mailed a questionnaire. Results were drawn from 347 filled questionnaires, which was 42% of total sample. About 52% had maintained their traditional native diet, 32.9% were bicultural and around 15% had acculturated. The changes included skipping some meals, therefore, there was a decrease in meal frequency with only 36% consuming 3-meals a day, and particularly breakfast was consumed the least frequent with only 43% consuming it. Most of the participants (58%) reported that they ate out at least one a week. There was a positive correlation between body weight and acculturation as it was found that around 28% of men and 6% of women participants were overweight. Acculturation was significantly associated with higher

frequency of snacking and eating out, and correspondingly showed higher prevalence of getting overweight among men (Lee 2008).

According to the US Census Bureau, Latinos are the largest growing minority in the U. S and it is estimated that by 2050, one-fourth of the US population will comprise of Latinos (Bureau 2004). A study was conducted to study the relationship between acculturation, years in the US and macronutrient intake. Subjects were older Hispanics and non-Hispanic white, aged 60 and older. The results showed that older Hispanics had greater ability to acculturate, ate less ethnic foods and had dietary patterns similar to white counterparts. This shows a lesser degree of commitment to native diet among older Hispanics (Bermudez, Falcon et al. 2000).

Pierce et al., 2007 studied the dietary acculturation and its influence on increased risk in development of type II diabetes in Japanese Americans by estimating measures for diabetes and 2 risk factors associated with diabetes-BMI and c-reactive-protein (CRP). A cross-sectional study data from the sample of 496 respondents was used to analyze the confirmatory factor. This study analyzed the acculturation pattern based on a five itemed Japanese diet (Fish, rice, tsukemono, tofu, and soy source) and five-itemed Western Diet (cheese, meat (beef), poultry, snacks (chips, crackers, popcorn and soda). Results showed that the second generation had a higher factor score for Japanese diet as compared to the third generation. Impressively, the Western diet factor score of the third generation respondents was significantly associated with increased plasma CRP, BMI and diabetes prevalence (Pierce, Austin et al. 2007). This study confirms that the dietary acculturation among third generation Japanese Americans resulted in a shift in the dietary pattern which may be the leading cause of increased prevalence of obesity. In the majority of cases, changes in dietary habits result in change in health status and susceptibility to chronic disease; thus ethnic minority groups should be encouraged to maintain their traditional healthy eating practices and be encouraged to adopt healthful eating habits of the host country (Satia-Abouta, Patterson et al. 2002).

2.4 Dietary habits among international students

The US hosts the highest number of international students worldwide. During the 2002-2003 academic years, a total of 586,323 international students were enrolled in various U.S. colleges.

Enrollment of international students continued to increase steadily; and the international students comprised 4.6% of all college students in the U.S (Institute of International Education. 2004). International students are increasing in the U.S; however, there have not been enough studies about the change of their dietary patterns due to migration.

Undesirable changes in diets of foreign students have been reported by Pan et al., (1999) in a study of Asian students living in the United States for at least 3 months. Participants were 18 years and older university students originally from China, Hong Kong, Taiwan, Korea and Japan. A survey was developed including questions related to background, changes in eating habits, and eating frequency. Out of 120 mailed questionnaires, data were analyzed from 63 applicants. The participants were consuming more salty and sweet snacks, fat, dairy products and fruits; however, there were noticeable decrease in consumption of vegetables and meats. Number of students taking two meals daily had increased. If compared with the dietary habits in their native countries, 46% of the Asian students living in the US have skipped breakfast. Around 57% of the subjects were consuming American style fast meals including burger, pizza, and fries and carbonated beverages. The dietary changes of Asian students were influenced by cooking inexperience, lack of time, a lack of availability of ethnic foods, poor quality of ethnic foods and un-affordability of ethnic foods (Pan 1999).

International students all over the world face many challenges of adaptation including adopting new dietary habits. Not only in the US, the immigrant students in other international locations all over the world also go through the process of dietary acculturation. For instance, Greek immigrant students in Glasgow, UK had significantly decreased consumption of fresh fruits, raw vegetables, fish, legumes, meats, poultry, and juices. This was accompanied by an increased intake of biscuits, savoury snacks, soft and frozen drinks, alcoholic beverages, mayonnaise, dips and sauces. The unavailability of fresh fish, milk, good quality meat, variety of foods, expensive cost affected their food choices. There was a decrease in the estimated median daily fruit and vegetable consumption from 363 gm in Greece to 124 gm in UK, which was below the recommended daily allowance of 400 gm according to WHO. There was weight gain in 10 out of 40 males studied, 18 out of 40 females, weight loss in 11 out of 40 males, 12 out of 40 females; weight was stable in 17 out of 40 males, 8 out of 40 females. The main reasons for the alteration in their dietary patterns were linked to lack of time to cook, prices of food, and un-palatibility of

food items. This coincided with increased accessibility of convenience foods and limited food choices in Glasgow when compared to Greece. All of these factors and barriers forced the immigrants to switch from their traditional dietary habits to the foreign ones (Papadaki and Scott 2002).

In another study dietary changes and their health implications were assessed among 508 Taiwanese students studying in four U.S. universities. The response rate for the questionnaires was 32%. Majority of respondents were males (21 to 30 yr old), living without family. More than half of the respondents reported gain in weight since coming to the US and a majority were not familiar with the USDA Food Guide Pyramid. Students preferred fried chicken, steak, and salad rather than breakfast cereal and cheese. After coming to the U.S., respondents started consuming more chicken, milk, eggs, beef, Coke, and ice cream and had decreased intake of fish/shell fish, spices and Chinese tea, rice, and monosodium glutamate. Taiwanese students were eating the daily recommended servings of the four food groups except for dairy products. The dairy product consumption was less than one serving per day. Students were eating more vegetables than fruits, with a total five servings of vegetables and fruits daily. Interestingly, participants consumed cheese and breakfast cereals only after migrating to the US. This study emphasizes the importance of creating programs in order to educate international students about how to make better and healthier food choices according to the USDA Food Guide Pyramid (Kuo 1996).

A study was performed to investigate food practices, changes, preferences, and acculturation of Thais in the US. A questionnaire was mailed to Thailand-born 182 individuals who had been in the US for at least 3 months and were 18 years or older; 102 (56%) participants completed questionnaires of which 62 were university students and 40 were residents from five states. During their stay in the US, the frequency of meals decreased significantly and there was a transition of snacks and food eaten out from Thai to American. In the questionnaire there was a list of 111 Thai and American food items. The results showed that there was a significant decrease in the frequency of consumption of 29 Thai foods which was accompanied with a significant increase in consumption of 33 American foods and total milk food group. The mean daily consumption of the food groups were 3.5 bread; 3.8 vegetables; 2.2 fruits; 3.6 meat; 1.6 milk; 3.9 fats, oils, and sweets; 2.2 beverages; and 0.9 Thai mixed dishes. Of the 111 food items listed, 91 were preferred (mean 5.5 or higher on a 9-point hedonic scale). There was a positively

correlation between 77 food items and their consumption frequency and preference. There was a significant positive correlation for consumption and preference for some American foods and vice versa for some Thai foods. There was dietary acculturation (mean 2.6, 1 to 5 scale) (Sukalakamala and Brittin 2006).

Satia-Abouta and colleagues (2002) suggest that public health should have an important objective encouraging the new migrated groups to maintain their traditional eating patterns and to try to adopt only healthy dietary practices of the host country. Several studies strongly recommend creation of a nutrition and health promotion program to benefit the international community. These awareness programs will help reduce the tendency of weight gain and reduce the risk of obesity and other chronic illness (Constance and K. Peters. 1997).

2.5 Standard Survey Data Collection Methodologies

Currently, there are several procedures utilized to collect data from a sample of human populations for studies pertaining to demographics, behavior, health, social science and marketing research and dietary patterns. There are different methods for collecting data such as telephone, mail, online, and personal surveys. For example, the use of the telephone is a practical, feasible and valid method for collecting 24-hour dietary recall data in national food consumption surveys (Casey, Goolsby et al. 1999). Use of telephone interviews for large-scale studies may decrease costs by as much as 50-75% (Fox, Heimendinger et al. 1992) and increase access to remote and unsafe locales (Lyu, Hankin et al. 1998). Samples of 1338 randomly selected subjects from 9 different states, using zip code, were mailed a survey about demographics, attitudes and behaviors and food-frequency. Only 43% of the mailed surveys were returned for data analysis (Constance and K. Peters. 1997). The chance of getting a 100% response rate in mailed-type survey is not feasible as there is no possible way to ensure the commitment of the subjects.

We chose the best way to ensure the commitment of subjects and to have consistent data by having the participants fill in a self administered survey that was filled in person following the pattern of the studies mentioned. A survey of 220 students chosen randomly from Lebanese American University campus during the fall 2006 semester were asked to fill out a questionnaire

that included questions on their eating, drinking and smoking habits (Yahia, Achkar et al. 2008). In addition another study used the same methodology as a self administered questionnaire was given to Greek postgraduate students who were at the University of Glasgow, UK, for less than a year. Data about socio-demographic characteristics, general food habits and consumption frequency of selected food items were collected (Papadaki and Scott 2002).

Chapter 3. Research Objective

3.1 Rationale of the Study

All the findings in the literature review (Chapter 2) support the idea that dietary acculturation is a critical issue which merits attention. Most of the studies on dietary acculturation showed that the dietary practices of people arriving in the United States from other countries are influenced by migration and they tend to shift from a healthier diet of their native country to fast-food items. Many of these studies support our hypothesis that the international students are more prone to change their dietary patterns, therefore, more susceptible to gain weight, change their blood pressure levels, and have a higher risk of type II diabetes.

Virginia Tech is one of the prestigious universities in the US and is a main attraction for many international students. According to the Cranwell International Centre statistics for year 2010, there are 2322 international students from 113 countries enrolled in undergraduate (497) and (1825) graduate programs. Since Virginia Tech is a home to students of different nationalities we wanted to assess the dietary acculturation of the recently enrolled international students, and observe their degree of commitment to their native diet. In addition, we evaluated the changes in their health status in terms of weight, systolic blood pressure, and fasting blood glucose.

3.2 Research Questions

Having reviewed the literature regarding dietary habits and behaviour patterns of young adults and students, and general overview of American diet, the two critical questions to be addressed are:

1. How do the dietary habits of international student's change over time after coming to Virginia Tech, United States?
2. Are there any positive or negative changes in the health status of international students upon their arrival and establishment in the U.S.?

3.3 Central hypothesis

The central hypothesis of this research is that recently enrolled international students will have dietary acculturation over time (August-December; Fall-2010) which will potentially have some health implications due to alteration in their dietary practices.

3.4 Hypothesis 1:

Newly admitted international single students will alter their dietary patterns due to migration to Blacksburg, VA.

3.5 Specific Aim 1:

We approached recently immigrated international graduate and undergraduate students enrolled at Virginia Tech (age 18-36 yrs) to study their dietary patterns and health status after arriving in the U.S. We assessed changes in their dietary habits, evaluated their acculturation to the American diet, and the degree of their commitment to their native diet by conducting a survey containing a series of questions in a questionnaire format.

3.6 Hypothesis 2:

The international students will gain weight, and will possibly show markers/early symptoms of diabetes and hypertension.

3.7 Specific Aim 2:

We determined any possible negative or positive changes in health status indicated by body weight, blood pressure and fasting blood glucose levels.

3.8 Approaches

In this research, changes in the dietary pattern of recent migrated international students, who are single or live without their spouses and families, (18 – 36 yrs of age) were analyzed at 3 different time periods: (i) The first period was the baseline- time when the students first arrive on campus for orientation; (ii) The second period was in the middle of semester approximately six weeks

after visit one; and (iii) The third period was the end of semester. The timeline for data collection was 11 weeks, and an additional 2 weeks for data analysis.

1. A list of the most commonly consumed food items of the American diet were created and given to the participants to measure their degree of acculturation over the period of 11 weeks.
2. The questionnaire also included the items regarding behavioral attitudes towards American and native food.
3. The respondents were tested for changes in body weight, and were assessed for early indicators of hypertension, and diabetes.

Chapter 4. Materials and Methods

4.1 Study Design

A longitudinal-study was carried out on 42 newly arrived single international students at Virginia Tech. The study was approved by University's Institutional review board. The study was divided into 3 time periods during Fall Semester 2010; (i) V1 baseline took place in the beginning of fall semester (August 30th, 31st and September 1st till September 10th), (ii) V2 took place in mid semester (October the 11th, 12th, 13th and 18th) and (iii) V3 occurred towards the end of semester (November the 15th, 16th, and 17th.). Data was collected using self-administered survey (Lee 2008; Yahia, Achkar et al. 2008). In addition, participants were tested for changes in body weight, height, blood pressure and fasting blood glucose levels. Data was collected on paper and was transferred to an Excel spread sheet after each visit to avoid any chances of error i.e. mixing value. The actual analysis of the data was performed after the end of the third visit so we can compare results from V3 to V1.

4.2 Subject Recruitment and Retention

Our sample was taken from students who were recently arrived and were single international students. Those living without their families of any ethnicity or country of origin were approached through Cranwell International Center/Graduate Life Center via VT Listserv. An invitation to participate in the study was sent by e-mail to different international clubs at Virginia Tech including Chinese, Indian, Pakistani, Saudi Arabia, South American students club. The email explained the nature and objective of the study, privacy policy and the financial compensation. The students who were eligible and were willing to participate were contacted. The participants were asked to sign a letter of consent explaining the nature of the study and the privacy policy and disclaimer. The participants were asked to be committed to this study for all three time points in order to receive the monetary compensation of \$50 "Kroger" gift cards for their participation. However, they were notified that their participation and commitment was totally voluntary. The Compensation was prorated for three time periods. We gave a \$5 gift card for first period which was the baseline- time after a week of beginning of school; (ii) Second period was in the middle of semester a week before Fall break and we gave a \$15 gift card; and

(iii) Third period was a week before Thanksgiving break and we gave a \$30 gift card. The participants were free to come based on their convenience between these hours of 9:00 A.M. - 05:00 P.M. on the three assigned dates for data collection at Litton Reaves Hall room 1018.

Anthropometric measurements, blood pressure readings and fasting blood glucose test were done in Litton Reaves hall room 1018. The participants were instructed on how to fill out the questionnaire, frequency table and 24 hours dietary recall. Beverages and snacks were provided after these tests.

Subjects taking health care medications that affect appetite were excluded. The subjects were free-living, practicing normal daily activities, and were not required to alter their diet and exercise for this study.

4.3 Sample size and composition

Initially we had 42 participants and ended up with 35 total sample populations (TSP). Seven people dropped out during the study period. The nationalities of the participants were 40% (n=14) Chinese, 20% (n=7) Indians, 11% (n=4) Germans, 6% (n=2) South African, and Koreans, 17% (n=1) participants from other countries i.e. Finland, Italy, Egypt, Vietnam, Bangladesh, Nepal and Saudi Arabia.

The age of the participants ranged from 18 – 36 years, 48% (n=17) of the TSP were from the age group of 18-23. Forty three percent (n=15) of the TSP were from the age group of 24-29. Nine percent (n=3) remaining TSP were from the age group of 30 and older. Fifty one percent TSP were female and remaining 49% of the TSP were male. Seventy seven percent (n=27) TSP was living off campus where as 23% (n=8) remaining TSP was living on campus. Eighty six percent of the TSP (n=30) were grad students whereas 14% (n=5) of the TSP were undergrads.

4.4 Anthropometric and Clinical Measures

Anthropometric measurements that include height were determined using a wall that was marked with feet and inches. Participants were asked to remove their shoes and stand on the floor looking outwards straight ahead. The head, shoulder, rear end and heels were straight. The ruler

was placed right above the head without any pressure. The reading was written down on a table that had participant number and names. To measure the weight, we used digital “Weight Watcher” weighing scale. Participants were asked to remove their shoes and step on the scale. The readings were recorded and included in the data for analysis. The weight of participants was measured at 3 time points to analyze their weight changes.

The participants were asked to fast 5 hours before coming to perform the test for blood glucose levels by using “FreeStyle Lite Blood Glucose Monitoring System”. The process of monitoring the blood glucose begins with (i) wiping the chosen finger using alcohol wipes (ii) pricking the finger with pen needle until we had good drop of blood (iii) apply it to the darker area of the test strip (iv) inserted the test strip into the meter (v) take the reading from the screen and recorded them on our sheets next to the participant names and numbers.

Blood pressure was measured by using “CVS/pharmacy digital advanced wrist blood pressure monitor”. The process of using the blood pressure monitor was (i) Place the cuff around the wrist and turn the power on. (ii) The cuff was inflated automatically by pressing the start mode. (iii) The inflated cuff will automatically start to deflate slowly by reducing the cuff pressure around the arm when it reaches the maximum level. (iv) The systolic and diastolic blood pressure reading would show on the screen of the display window and then by pressing the exhaust button will release all the pressure. (v) The readings were written down and recorded in data collection for each participant.

There were three time periods for our data collection which was located in Litton Reaves Hall. In all three time periods, participants underwent the same procedure except for signing the consent form and taking the height measurement which took place at the first time period only. We had 4 stations to receive the participants in groups. First station was to sign the consent form and give an anonymous serial number. Second station was taking blood glucose level that was done by Amal Almohanna. Participants were able to help themselves to have some refreshments to break their fast if they wished. Third station was for taking blood pressure which was be done by Dr. William Barbeau. The fourth station was for taking weight and heights that were taken by Dr. William Barbeau. The participants were comfortable in the room and began filling the questionnaires. Amal Almohanna was accompanying participants to answer any questions.

4.5 Survey Based Questionnaire

Initially we started with 65 item self report questionnaires however we ultimately selected 20 items to analyze from this questionnaire. Questions were chosen that would best serve the research project due to time restrictions; furthermore questions that were eliminated were more of a personal nature. Multiple choice questions were developed to assess dietary practices and eating pattern of the participants. We asked some participants some questions regarding their meal consumption patterns because we had a heterogeneous population. To ensure that questionnaire was valid, a clear and purposeful pilot test on international students (n=35) was performed in *Summer II 2010*. The feedback from the voluntary participants of the pilot study was taken into consideration for any possible modification to the present version of the questionnaire.

In addition to anthropometric information and some demographics, items were designed to assess meal frequency, methods of food preparation, cooking rate and nutritional awareness. They were also asked about their degree of commitment to their native diet. (Appendix, pg 74)

The participants were asked to report food consumption in the last 24 hrs. The purpose of 24 hr dietary recall is to have a general understanding of diet of internationals and to do a calorie count for three days out of the 11 week study period. In this study, the calories intake was taken into consideration. We analyzed the 24 hrs dietary recall using Google calorie calculator. We entered each food item in calorie calculator to determine the total calorie count for all food items and whenever we could not identify an international food item the closet alternative was chosen (Appendix pg.83)

Participants were asked to fill a table of Food Frequency Questionnaire (Appendix pg. 84) which included a list of 73 most commonly consumed American food items. The list was categorized as beverages, proteins, carbohydrates, fats, vegetables, fruits, dairy and desserts. However we have selected four main groups out of 8 including beverages, proteins, carbohydrates and desserts with total 21 most famous items that were popular among young adults and college students. The first group was beverages which included; carbonated drink, flavored water, vitamin fortified and diet carbonated drink. The second group was proteins which included; burgers, peanut butter

pepperoni, meat loaf, chicken nuggets and hotdogs. The third group was carbohydrates which included mashed potatoes, pizzas, french fries, doughnuts, bagels, macaroni & cheese, granola bars and popcorns. The fourth group was desserts which included ice-cream, pies and brownies.

The food frequency table indicated the shift towards the American diet as it specifically listed most commonly consumed American foods. We analyzed the food frequency table by creating a scale from 0 – 4 and associating it with values of never=0, once a month=1, once a week=2, several times a week=3 and daily=4. We took the sum of these values and have taken the averages for comparing the total frequency consumption of the American food items by each participant at all three time periods.

4.6 Data Analysis

The data was collected and analyzed with the help of Laboratory for Interdisciplinary Statistical Analysis (LISA), the consulting lab for Statistical services at Virginia Tech. Student T-test was a statistical key test to determine significant difference in dependant variables including weights and food frequency between time period one and three using Microsoft Excel 2007. We did not include V2 in our analysis as we were more interested in the overall impact of the dietary acculturation. Furthermore, we also observed that there was not enough variation when comparing V1 to V2 or V2 to V3 to be able to perform any statistical analysis due to limitation of the time within the visits which was not long enough to detect clear marks of variations. We used JMP 08 to analyze dietary habits questionnaire for international student from V3 to V1. All *P* values were determined on the basis of two-sided T tests and compared to a significance level of 5%; differences were considered statistically significant at $p < 0.05$.

Chapter 5. Results

5.1 Effects on weights during three visits:

We started the research with 42 students, seven dropped out during the study therefore our total sample population (TSP) was 35 students who participated in the research: 40% (n=14) of them were Chinese, 20% (n=7) Indians, 11% (n=4) were Germans and 29% (n=10) students were from South Africa, Korea, Vietnam, Nepal, Italy, Finland, Egypt, Saudi Arabia and Bangladesh. We tested our hypothesis during the fall semester by having three main testing points. The first visit was in late August, the second visit followed six weeks later and the third visit was after five weeks.

Our main hypothesis was to test that international students are more prone to gain weight after migrating to the United States. We found an overall average increase in weight of 2.79 lbs for TSP between visit 3 and 1 which was significant at ($p= 0.00829396$) Table 1. Four participants lost weight of 4 lbs or more from V3 to V1.

From our population 28.5% (n=10) were participants who gained weights (PGW) and showed a total increase of 6 lbs or more during the four months testing period. According to Table 2 the total weight gain for all 10 participants was 90lbs which means 9 lbs (6%) per person (90 lbs / 10 PGW) in four months. Based on these findings we can extrapolate that by the end of year they will gain 27 lbs per person and if their study continues for four years the total weight they might gain could be around 108 lbs if they continue to gain weight at the present rate. Seventeen percent (n=6) of our total sample population showed a total average weight increase of 4.73 lbs which could lead to a total weight increase of around 14.19 lbs by the end of the school year which in term could be a total average increase of 56.76 lbs at the end of their graduation. This increase in weight is alarming and could indicate a dangerous trend if those participants were not more cautious in the future.

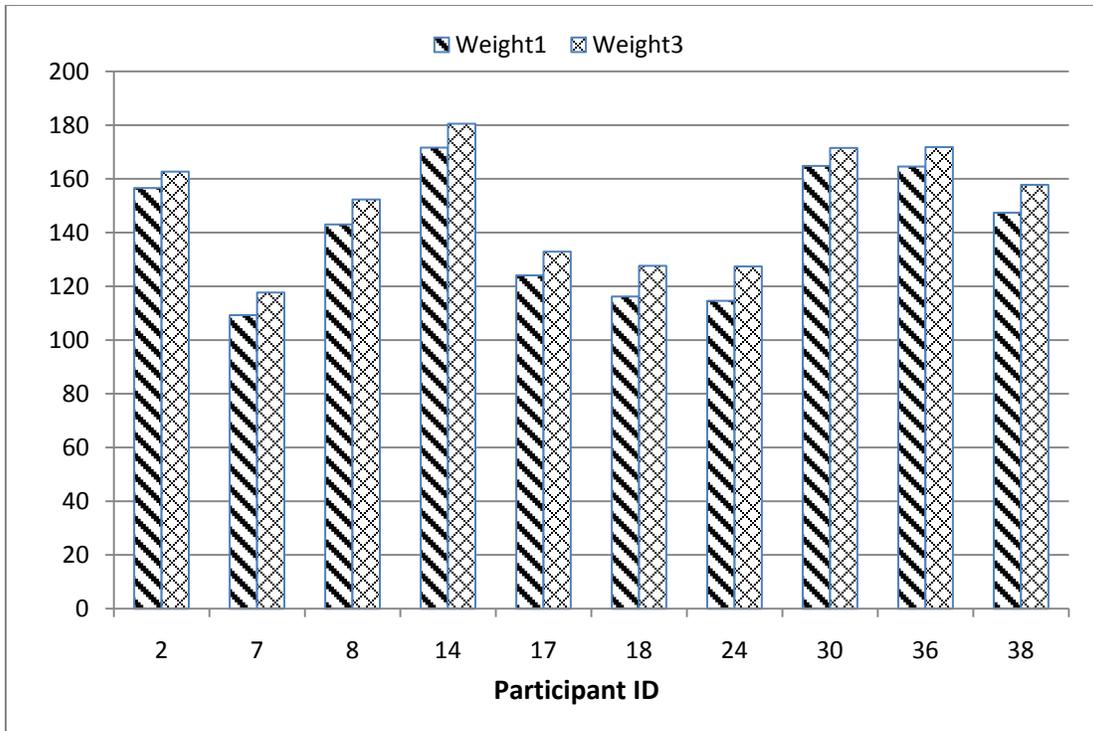


Figure 1: Weight variations for PGW from V3 to V1

The other 54% of the participants showed variation in their weights as some showed some increase and the others lost some weight.

Table 1: Weights in lbs for total sample population in all three visits

Sr. No	ID #	Nationality	Weight 1 lbs	Weight 2 lbs	Weight 3 lbs
1	1	China	148.5	146.2	146.9
2	2	Germany	156.6	162.2	162.7
3	4	Finland	125.4	140.3	125
4	5	Germany	139.7	140.3	142.4
5	6	South Korea	103.6	107.9	108.8
6	7	Korea	109.3	114	117.7
7	8	Italy	143	150.4	152.3
8	9	Germany	160.2	159.4	161.8
9	11	China	114.4	119.3	118.2
10	12	China	101.6	100.2	102.8
11	13	China	100.8	99.3	101.3
12	14	China	171.6	178.1	180.5
13	15	China	165.7	178.1	167.1
14	16	China	111.3	107.9	115.3
15	17	India	124.1	128	132.9
16	18	China	116.2	123.3	127.6
17	19	Egypt	139.7	143.4	143.5
18	20	South Africa	136.8	136.8	136.7
19	21	Germany	180.8	179.9	175.5
20	22	China	125.8	126.3	130.6
21	24	China	114.6	122.6	127.4
22	25	Vietnam	167.2	152.7	150.9
23	26	South Africa	187.7	188.6	192.1
24	27	China	142.3	140.2	136.6
25	28	China	98.1	101.2	103
26	30	China	164.8	166.3	171.5
27	31	China	109.6	112.3	114.7
28	33	India	118.4	117.7	118.4
29	34	India	129.8	130	133.2
30	35	India	150.9	148	147.5
31	36	India	164.6	169.6	171.8
32	38	Nepal	147.4	154.3	157.8
33	39	India	173.4	171.9	170
34	40	India	151.1	154	155
35	41	Saudi Arabia	195.1	190.1	188.3
		Average mean	139.72	141.74	142.51
		Total average mean weight gain per person from V3 to V1			2.79 lbs

Table 2: Weights in lbs for participants who gained weight in all three visits

Sr. No	ID #	Gender	Nationality	Height	Weight 1 lbs	Weight 2 lbs	Weight 3 lbs
1	2	M	Germany	5'11"	156.6	162.2	162.7
2	7	F	Korea	5'3"	109.3	114	117.7
3	8	M	Italy	5'7"	143	150.4	152.3
4	14	M	China	6'1"	171.6	178.1	180.5
5	17	F	India	5'4"	124.1	128	132.9
6	18	F	China	5'5"	116.2	123.3	127.6
7	24	F	China	5'5"	114.6	122.6	127.4
8	30	M	China	5'10"	164.8	166.3	171.5
9	36	M	India	6'5"	164.6	169.6	171.8
10	38	M	Nepal	5'9"	147.4	154.3	157.8
				Averages	141.22	146.88	150.22
			Average Weight Gain in 11 week per person for PGW				9 lbs

Weight 1 = weight in visit one, Weight 2 = weight in visit 2, Weight 3 = weight in visit 3

5.2 Effects on weights based on country of origin during three visits

Chinese comprised around 40% of the sample population and they showed a total average weight increase of 4.16 lbs. The percent increase for weight was 3.43% and the average weight gain was highly statistically significant by ($p=0.00775$) Table 3. The Indian students who comprised around 20% of the total sample population had a mean increase in their total weight average of 2.36 lbs with total 2% increase in their weights from visit three to visit one Table 4.

Germans who covered 11% of the total sample population had smaller average increase in their weights by 1.28 lbs. (0.8% from visit three to visit one Table 5) as compared to averages of the total population as well as Chinese (Table 3) and Indians (Table 4).

5.3 Effects on weights based on gender during three visits

Females ($n=18$) had a significant increase ($p=0.00153$) in their weights of 3.99 lbs/person (3.27%) from V3 to V1 Table 6. Males ($n=17$) did not show significant differences

($p=0.383644207$) in the weight from V3 to V1 however their average weight has increased by 1.52 lbs per person (0.9%) Table 7

5.4 Effects on Consumed Calories during three visits:

We counted the overall consumption of calories for TSP for three time periods during the Fall semester. There was no significant pattern ($p= 0.64658$) however there was an increase in the overall calorie consumption when comparing V3 to V1 which was 30.49 cal/person for TSP (1.75%) Table 8. Furthermore there was an increase in the consumed cal of PGW by 72.9 cal/person from V3 to V1 (4.35%) Table 9, however, it was not significant ($p= 0.469219$).

Table 3: Weights in lbs for Chinese students in all three visits

Sr. No	ID #	Nationality	Weight 1 lbs	Weight 2 lbs	Weight 3 lbs
1	1	China	148.5	146.2	146.9
2	11	China	114.4	119.3	118.2
3	12	China	101.6	100.2	102.8
4	13	China	100.8	99.3	101.3
5	14	China	171.6	178.1	180.5
6	15	China	165.7	178.1	167.1
7	16	China	111.3	107.9	115.3
8	18	China	116.2	123.3	127.6
9	22	China	125.8	126.3	130.6
11	24	China	114.6	122.6	127.4
12	27	China	142.3	140.2	136.6
13	28	China	98.1	101.2	103
14	30	China	164.8	166.3	171.5
15	31	China	109.6	112.3	114.7
		Average	127.52	130.09	131.68
		Average weight gain per person from V3 to V1			4.16 lbs

Table 4: Weights in lbs for Indian students in all three visits

Sr. No	ID #	Nationality	Weight 1 lbs	Weight 2 lbs	Weight 3 lbs
1	17	India	124.1	128	132.9
2	33	India	118.4	117.7	118.4
3	34	India	129.8	130	133.2
4	35	India	150.9	148	147.5
5	36	India	164.6	169.6	171.8
6	39	India	173.4	171.9	170
7	40	India	151.1	154	155
		Average	144.61	145.60	146.97
		Average weight gain per person from V3 to V1			2.36 lbs

Table 5: Weights in lbs for Germans students in all three visits

Sr. No	ID #	Nationality	Weight 1 lbs	Weight 2 lbs	Weight 3 lbs
1	2	Germany	156.6	162.2	162.7
2	5	Germany	139.7	140.3	142.4
3	9	Germany	160.2	159.4	161.8
4	21	Germany	180.8	179.9	175.5
		Average	159.325	160.45	160.6
		Average weight gain per person from V3 to V1			1.275

Table 6: Weights in lbs for females student in all three visits

Sr. No	ID #	Gender	Nationality	Weight 1 lbs	Weight 2 lbs	Weight 3 lbs
1	4	F	Finland	125.4	140.3	125
2	6	F	South Korea	103.6	107.9	108.8
3	7	F	Korea	109.3	114	117.7
4	11	F	China	114.4	119.3	118.2
5	12	F	China	101.6	100.2	102.8
6	13	F	China	100.8	99.3	101.3
7	16	F	China	111.3	107.9	115.3
8	17	F	India	124.1	128	132.9
9	18	F	China	116.2	123.3	127.6
10	19	F	Egypt	139.7	143.4	143.5
11	20	F	South Africa	136.8	136.8	136.7
12	22	F	China	125.8	126.3	130.6
13	24	F	China	114.6	122.6	127.4
14	27	F	China	142.3	140.2	136.6
15	28	F	China	98.1	101.2	103
16	31	F	China	109.6	112.3	114.7
17	33	F	India	118.4	117.7	118.4
18	34	F	India	129.8	130	133.2
			Average	117.88	120.59	121.87
			Average weight gain per person from V3 to V1			3.99 lbs

Table 7: Weights in lbs for males students in all three visits

Sr. No	ID #	Gender	Nationality	Weight 1 lbs	Weight 2 lbs	Weight 3 lbs
1	1	M	China	148.5	146.2	146.9
2	2	M	Germany	156.6	162.2	162.7
3	5	M	Germany	139.7	140.3	142.4
4	8	M	Italy	143	150.4	152.3
5	9	M	Germany	160.2	159.4	161.8
6	14	M	China	171.6	178.1	180.5
7	15	M	China	165.7	178.1	167.1
8	21	M	Germany	180.8	179.9	175.5
9	25	M	Vietnam	167.2	152.7	150.9
10	26	M	South Africa	187.7	188.6	192.1
11	30	M	China	164.8	166.3	171.5
12	35	M	India	150.9	148	147.5
13	36	M	India	164.6	169.6	171.8
14	38	M	Nepal	147.4	154.3	157.8
15	39	M	India	173.4	171.9	170
16	40	M	India	151.1	154	155
17	41	M	KSA	195.1	190.1	188.3
			Average	162.84	164.12	164.36
			Average weight gain per person from V3 to V1			1.52 lbs

Table 8: Overall calorie count for total sample population in all three visits

Sr. No	ID #	Nationality	Daily Calories 1 (cal)	Daily Calories 2 (cal)	Daily Calories 3 (cal)
1	1	China	1636	1309	1593
2	2	Germany	1784	1427	1489
3	4	Finland	1507	1809	1783
4	5	Germany	1306	1287	1543
5	6	South Korea	2100	1743	2043
6	7	Korea	1390	1482	1432
7	8	Italy	1538	1372	1702
8	9	Germany	2043	2094	1540
9	11	China	1983	2064	1714
10	12	China	2341	2107	1205
11	13	China	1854	3210	2053
12	14	China	2200	2483	2185
13	15	China	2080	1856	2081
14	16	China	1405	1387	1592
15	17	India	1876	1596	2248
16	18	China	1367	1409	1934
17	19	Egypt	1673	1332	1500
18	20	South Africa	1483	1395	1937
19	21	Germany	1304	1773	1376
20	22	China	1493	1584	2034
21	24	China	1593	1492	1382
22	25	Vietnam	1394	1789	1832
23	26	South Africa	2133	2100	1304
24	27	China	1402	1590	1238
25	28	China	2278	1434	1983
26	30	China	1239	1193	1303
27	31	China	1203	1398	2048
28	33	India	1992	1343	1906
29	34	India	1632	1483	1478
30	35	India	2153	1985	2493
31	36	India	1758	1406	2143
32	38	Nepal	1989	1953	1645
33	39	India	1845	1965	1983
34	40	India	2016	1995	2284
35	41	KSA	1994	1854	2045
		Average	1742.40	1705.69	1772.89
		Total average increase per person from V1 to V3			30.49 cal

Table 9: Calorie count for participants who gained weight

Sr. No	ID #	Nationality	Daily Calories 1 (cal)	Daily Calories 2 (cal)	Daily Calories 3 (cal)
1	2	Germany	1784	1427	1489
2	7	Korea	1390	1482	1432
3	8	Italy	1538	1372	1702
4	14	China	2200	2483	2185
5	17	India	1876	1596	2248
6	18	China	1367	1409	1934
7	24	China	1593	1492	1382
8	30	China	1239	1193	1303
9	36	India	1758	1406	2143
10	38	Nepal	1989	1953	1645
		Average	1673.40	1581.30	1746.30
		Total average increase per person from V1 to V3			72.90 cal

5.5 Effects on Blood Glucose Readings during three visits:

After performing the blood glucose tests for TSP during three visits we ended up with negative results showing a gradual decrease in the blood glucose levels by -25.69 Table 10, the decrease was 27.44% per person from visit three to visit one ($p=4.24$). Therefore we could not relate consuming the American diet with the increasing blood glucose. Moreover we ended up with the similar results for PGW Table 11 as they also showed a continuous reduction in their blood glucose levels by -20.1 which indicates that overall decrease was 20.92% from visit three to visit one ($p=0.060$) Table 11.

Table 10: Blood Glucose Levels in mg/dL for total sample population

Sr. No	ID #	Nationality	BG1 mg/dL	BG2 mg/dL	BG3 mg/dL
1	1	China	84	67	57
2	2	Germany	93	83	71
3	4	Finland	91	85	84
4	5	Germany	105	84	60
5	6	South Korea	75	88	59
6	7	Korea	94	83	103
7	8	Italy	96	93	76
8	9	Germany	94	83	55
9	11	China	91	91	51
10	12	China	87	88	95
11	13	China	121	85	72
12	14	China	111	90	51
13	15	China	111	90	62
14	16	China	96	106	73
15	17	India	106	101	83
16	18	China	56	83	81
17	19	Egypt	95	63	66
18	20	South Africa	93	95	56
19	21	Germany	83	86	58
20	22	China	89	86	57
21	24	China	157	84	84
22	25	Vietnam	91	86	74
23	26	South Africa	89	92	53
24	27	China	89	64	65
25	28	China	88	117	67
26	30	China	72	93	75
27	31	China	96	84	58
28	33	India	97	96	61
29	34	India	89	82	73
30	35	India	95	70	55
31	36	India	88	93	75
32	38	Nepal	88	73	61
33	39	India	85	83	55
34	40	India	91	78	77
35	41	KSA	90	76	74
		Average	93.60	85.74	67.91
Average blood glucose per person from V3 to V1					-25.69 mg/dL

BG 1= Blood Glucose in visit one, BG2= Blood glucose in visit 2, BG3 = Blood glucose in visit three

Table 11: Blood Glucose in Levels in mg/dL for participants who gained weight

Sr. No	ID #	Nationality	BG1 mg/dL	BG2 mg/dL	BG3 mg/dL
1	2	Germany	93	83	71
2	7	Korea	94	83	103
3	8	Italy	96	93	76
4	14	China	111	90	51
5	17	India	106	101	83
6	18	China	56	83	81
7	24	China	157	84	84
8	30	China	72	93	75
9	36	India	88	93	75
10	38	Nepal	88	73	61
		Average	96.1	87.6	76
		Average blood glucose per person from V3 to V1			-20.1 mg/dL

5.6 Effects on Systolic Blood Pressure Readings during three visits

The TSP showed an overall decrease in the SBP by -3.20 (p=0.20183) Table 12, which means that the blood pressure was decreased by 2.22% in TSP from V3 to V1. Therefore we couldn't relate consuming the American diet with increasing the overall SBP. On the other hand we had slightly positive correlation between gaining weight and high SBP by 2.7 which is an increase of 2.31% (p=0.533) Table 13.

Table 12: Systolic Blood pressure in mmHg for total sample population

Sr. No	ID #	Nationality	SBP1 mmHg	SBP2 mmHg	SBP3 mmHg
1	1	China	130	120	108
2	2	Germany	102	95	112
3	4	Finland	104	104	114
4	5	Germany	113	118	113
5	6	South Korea	96	116	107
6	7	Korea	107	103	105
7	8	Italy	127	115	123
8	9	Germany	122	126	117
9	11	China	117	91	96
10	12	China	115	111	105
11	13	China	91	99	90
12	14	China	115	100	138
13	15	China	115	100	132
14	16	China	96	154	104
15	17	India	98	106	102
16	18	China	116	91	119
17	19	Egypt	131	113	104
18	20	South Africa	132	101	124
19	21	Germany	139	120	123
20	22	China	108	108	104
21	24	China	118	116	117
22	25	Vietnam	106	113	124
23	26	South Africa	143	102	107
24	27	China	105	102	115
25	28	China	88	97	91
26	30	China	142	129	115
27	31	China	106	101	106
28	33	India	112	114	95
29	34	India	135	99	102
30	35	India	116	105	115
31	36	India	114	126	127
32	38	Nepal	103	112	111
33	39	India	125	126	121
34	40	India	117	126	116
35	41	KSA	138	148	128
		Averages	115.49	111.63	112.29
		Average blood pressure per person from V3 to V1			-3.20 mmHg

SBP1 = Systolic Blood Pressure in visit one, SBP2= Systolic Blood Pressure in visit two, SBP3= Systolic Blood Pressure in visit three

Table 13: Systolic Blood Pressure in mmHg for participants who gained weight

Sr. No	ID #	Nationality	SBP1 mmHg	SBP2 mmHg	SBP3 mmHg
1	2	Germany	102	95	112
2	7	Korea	107	103	105
3	8	Italy	127	115	123
4	14	China	115	100	138
5	17	India	98	106	102
6	18	China	116	91	119
7	24	China	118	116	117
8	30	China	142	129	115
9	36	India	114	126	127
10	38	Nepal	103	112	111
		Average	114.2	109.3	116.9
		Average blood pressure per person from V3 to V1			2.7 mmHg

5.7 Average frequency of the most often consumed American food items during three visits

There was an overall increase in the consumption of the American food items by the TSP. Table 14 shows that there was an overall increase of 4.07% which means that TSP consumed more American food items from visit three to visit one. The average consumption of carbonated drinks was the highest however the increase from visit three to visit one is not high enough to be considered as significant. Burgers frequency of consumption was continuously increasing with a significant level of $p=0.027$. Pizza intake was high however it's not high enough to be considered significant with $p=0.66$. Ice-cream intake was also increasing but not significantly with $p=0.68$. Similarly mashed potatoes consumption scored fifth in our frequency list however it was not significant with a $p= 1$. Additionally, there was decrease in the consumption of eight food items and consumption of two food items remained the same Table 14

Furthermore for PGW there was a continuous increase in percentages of American food. The total American food intake was increased by 3.00% (Table 15) from visit three to visit one which is lesser than the increase in TSP (4.07%) however the total food intake in PGW was 19.77 / visit

which was more than the average of TSP at 19.05 / visit. Burger consumption was continuously increasing however its increase was not significant with $p=0.591$. The only significant increase in consumption was found in bagels with $p=0.015$

Figure 2 shows the most consumed American food items for TSP among which the top five consumed food items were carbonated drinks followed by burgers, pizza, ice-cream and mashed potatoes. Thus the consumption of these items might help to explain the slight weight increase of 2.79 lbs / person from visit three to visit one. Furthermore PGW showed more significant increase in their total weight i.e. 9lbs / person from visit three to visit one which perhaps can strongly be connected towards consumption of American food items. The top five consumed food items in PGW was burgers, mashed potatoes, carbonated drinks, pizzas and french fries.

Table 14: Some of the frequently consumed food items for total sample population

Food Items	M1	M2	M3	Average M1+M2+ M3	Percentages of Averages	P Values
Carbonated drink	1.66	1.83	1.74	1.74	9.15%	0.702
Burgers	1.43	1.54	1.91	1.63	8.55%	0.027
Pizza	1.63	1.29	1.63	1.51	7.95%	0.661
Ice cream	1.40	1.40	1.49	1.43	7.50%	0.680
Mashed potatoes	1.26	1.43	1.26	1.31	6.90%	1
French fries	1.31	1.29	1.26	1.29	6.75%	0.781
Mac & Cheese	1.31	1.20	0.91	1.14	6.00%	0.075
Doughnuts	1.09	0.83	1.06	0.99	5.20%	0.850
Brownies	1.03	0.86	0.91	0.93	4.90%	0.613
Peanut butter	0.60	0.91	0.74	0.75	3.95%	0.500
Pies	0.71	0.57	0.83	0.70	3.70%	0.512
Pepperoni	0.71	0.51	0.77	0.67	3.50%	0.807
Chicken nuggets	0.49	0.80	0.69	0.66	3.45%	0.147
Flavored water	0.54	0.63	0.71	0.63	3.30%	0.487
Hotdogs	0.69	0.69	0.51	0.63	3.30%	0.263
Meat loaf	0.77	0.63	0.46	0.62	3.25%	0.182
Granola bars	0.54	0.54	0.71	0.60	3.15%	0.430
Bagels	0.43	0.63	0.69	0.58	3.05%	0.152
Diet carbonated drink	0.51	0.37	0.66	0.51	2.70%	0.473
Vitamin fortified	0.40	0.40	0.43	0.41	2.15%	0.889
Popcorn	0.34	0.29	0.29	0.30	1.60%	0.571
Avg. total consumption at three time periods	18.86	18.63	19.66	19.05		
	M2-M1	M3-M2	M3-M1			
Percentage for TSP	1.22%	5.24%	4.07%			

M1= Sample Mean for Visit one, M2 = Sample Mean for Visit two, M3 = Sample Mean for Visit three

Table 15: Some of the most frequently consumed food items for participants who gained weight

Food items	M1	M2	M3	Average M1+M2+ M3	Percentages of averages	P
Burgers	1.9	2	2.2	2.03	10.29%	0.591
Mashed potatoes	1.7	1.9	1.5	1.70	8.60%	0.555
Carbonated drink	1.7	1.6	1.3	1.53	7.76%	0.422
Pizza	1.4	1.5	1.6	1.50	7.59%	0.591
French fries	1.3	1.7	1.3	1.43	7.25%	1
Ice cream	0.8	1.3	1.5	1.20	6.07%	0.191
Peanut butter	0.7	1.5	0.9	1.03	5.23%	0.705
Doughnuts	1	0.8	1.1	0.97	4.89%	0.591
Pepperoni	0.9	0.6	1.2	0.90	4.55%	0.576
Pies	1.1	0.6	1	0.90	4.55%	0.726
Brownies	0.8	0.8	1.1	0.90	4.55%	0.278
Bagels	0.3	0.9	1.3	0.83	4.22%	0.014
Flavored water	1	0.8	0.6	0.80	4.05%	0.443
Meat loaf	1	0.7	0.5	0.73	3.71%	0.426
Mac & cheese	1	0.7	0.3	0.67	3.37%	0.110
Granola bars	0.7	0.5	0.7	0.63	3.20%	1
Chicken nuggets	0.5	0.5	0.5	0.50	2.53%	1
Vitamin fortified	0.4	0.5	0.5	0.47	2.36%	0.847
Popcorn	0.5	0.3	0.4	0.40	2.02%	0.591
Hotdogs	0.4	0.6	0.2	0.40	2.02%	0.167
Diet carbonated drink	0.3	0.1	0.3	0.23	1.18%	1
Average total consumption	19.40	19.90	20.00	19.77		
	M2-M1	M3-M2	M3-M1			
Percentage for PGW	2.51%	0.50%	3.00%			

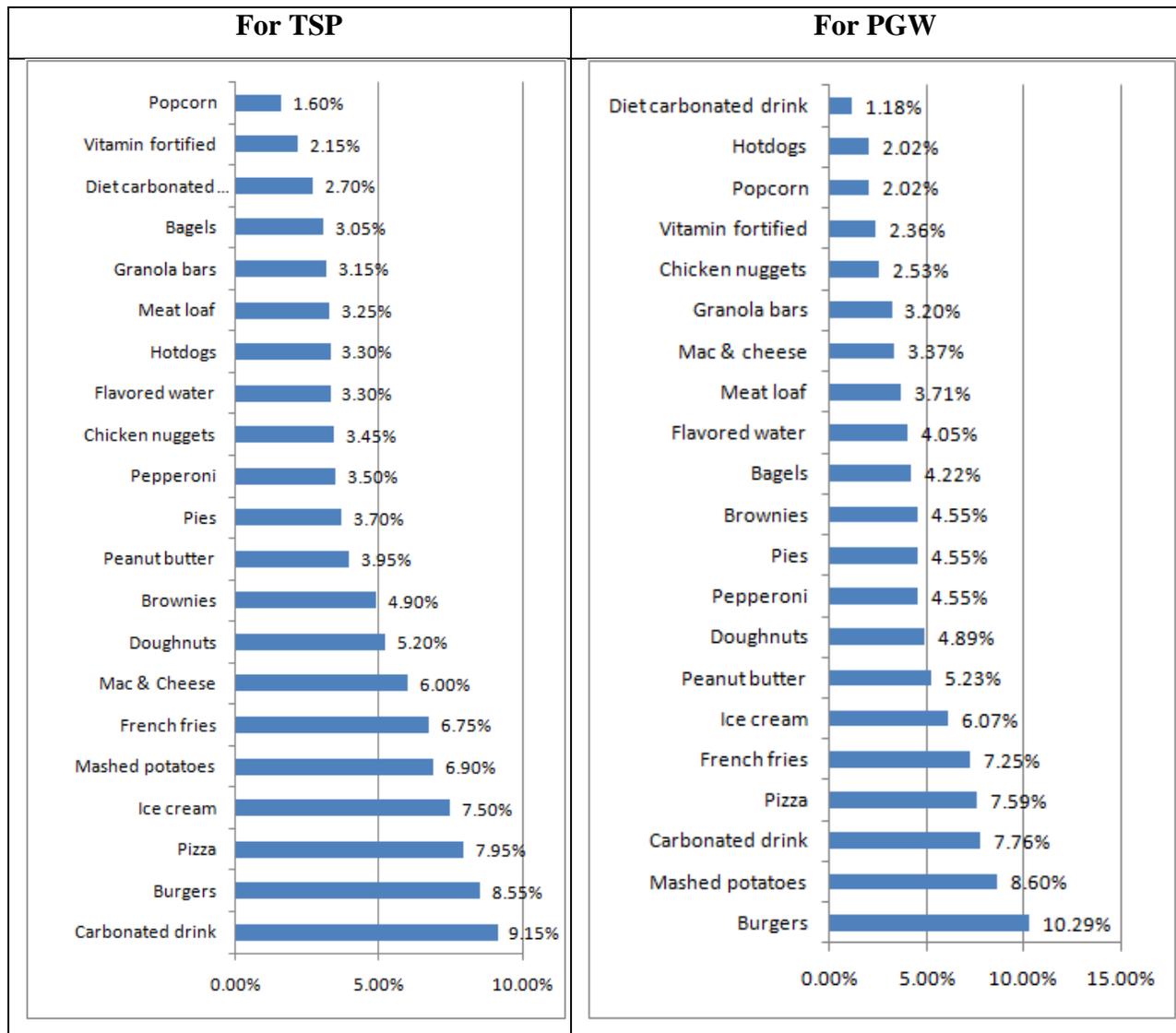


Figure 2: Some of the most consumed food items for TSP and PGW

5.8 The most consumed beverages during three time periods:

According to Figure 3 carbonated drinks were the most frequently consumed beverage among TSP with an average consumption of 1.74 / visit as compare to fortified vitamin water which was the least consumed beverage with an average consumption of 0.41 / visit. Carbonated drink is also the most frequently consumed beverage in PGW with the total average consumption of 1.53 / visit. On the other hand the least consumed beverage in PGW is diet carbonated drink with an average of 0.23 / visit

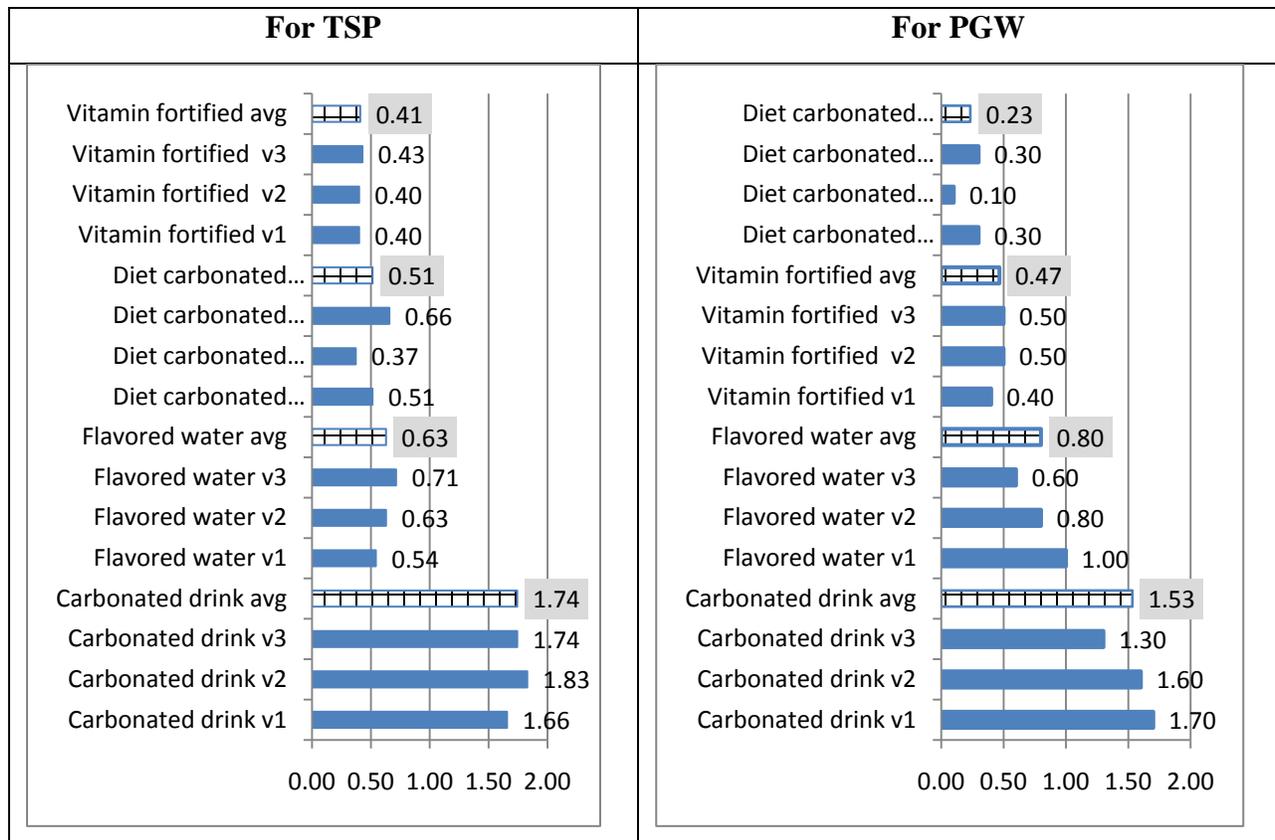


Figure 3: Average consumption of some beverages in TSP & PGW

5.9 The most frequently consumed proteins at three time periods:

Figure 4 shows that the most frequently consumed protein was burger with an average consumption of 1.63 / visit for TSP and the least consumed protein was meat loaf with an average consumption of 0.62 / visit. In PGW burgers were the highest in consumption with an average of 2.03 / visit and the least consumed protein was hot dogs with an average consumption of 0.40 / visit.

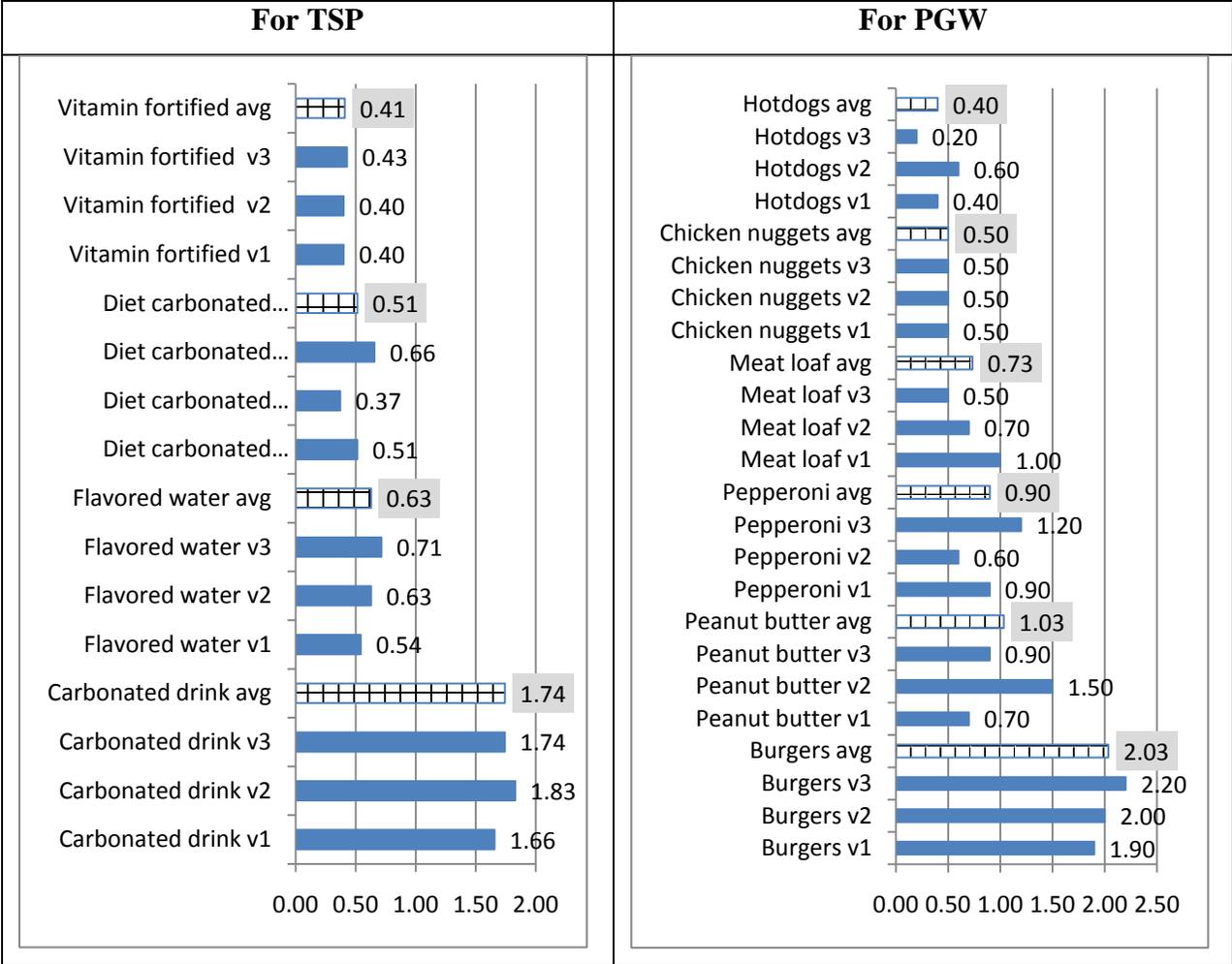


Figure 4: Average consumption of some Proteins for TSP & PGW

5.10 The most frequently consumed carbohydrate at three time periods:

Figure 5 shows that the most frequently consumed carbohydrates were pizza and mashed potatoes for both groups. For TSP the average consumption of pizza was 1.51 per visit. The least consumed carbohydrate was popcorn with an average consumption of 0.30 per visit. In PGW, however, the most consumed carbohydrate was the mashed potatoes with an average of 1.70 / visit and the lowest was popcorn with an average of 0.40 / visit. Therefore the high frequency of consuming pizza and mashed potatoes could indicate one reason of gaining weight for both groups as both food items are considered to be high in fats and carbohydrates.

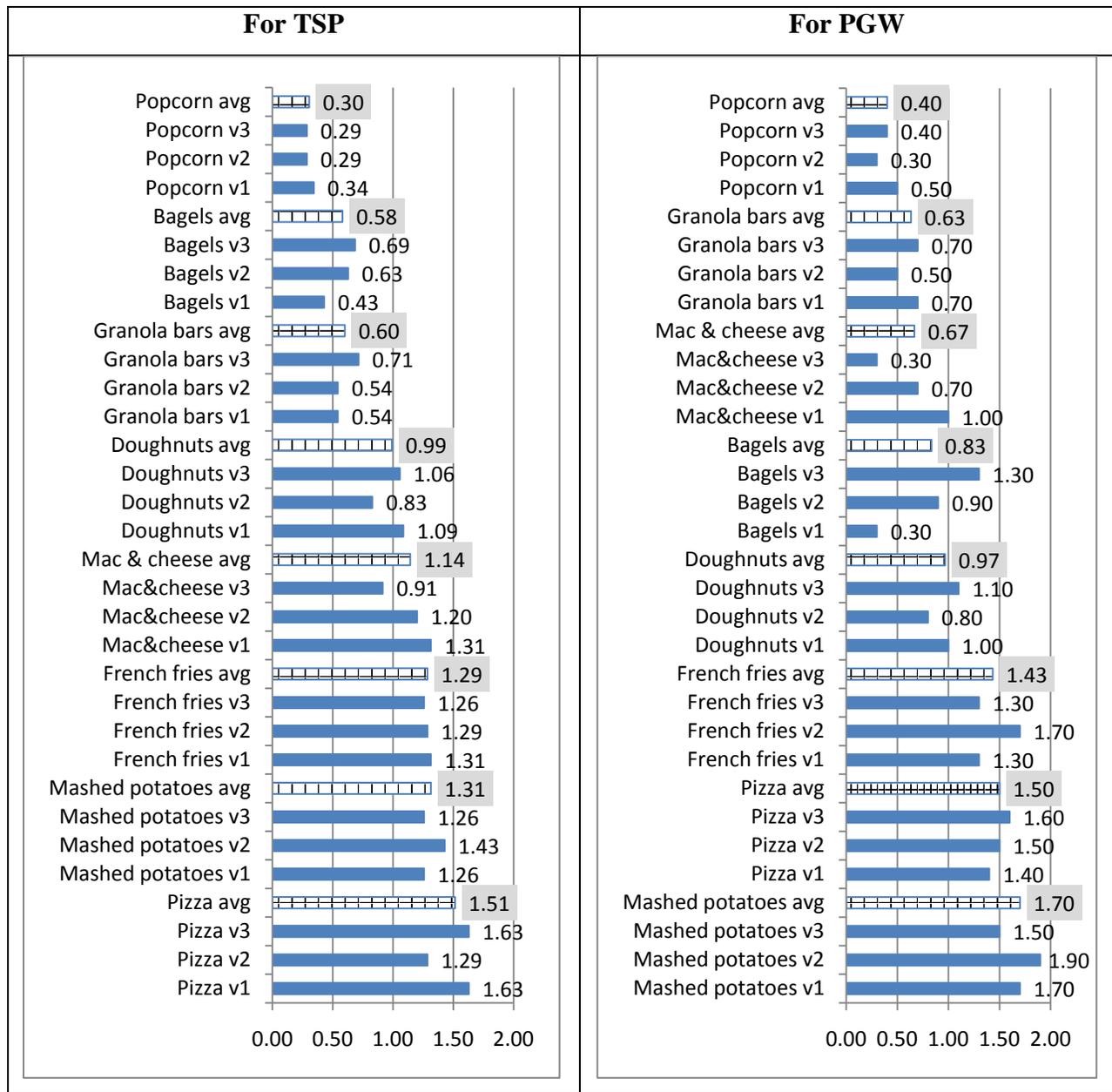


Figure 5: Average consumption of some carbohydrate for TSP and PGW

5.11 The most frequently consumed Desserts at three time periods:

The most frequently consumed dessert was Ice-cream Figure 6 with an average consumption of 1.43 / visit for TSP and the least frequently consumed dessert was pie with an average consumption of 0.70 / visit. In PGW ice-cream was also the highest in consumption with an

average of 1.20 / visit and the least consumed dessert were pies and brownies with similar average consumption of 0.90 / visit.

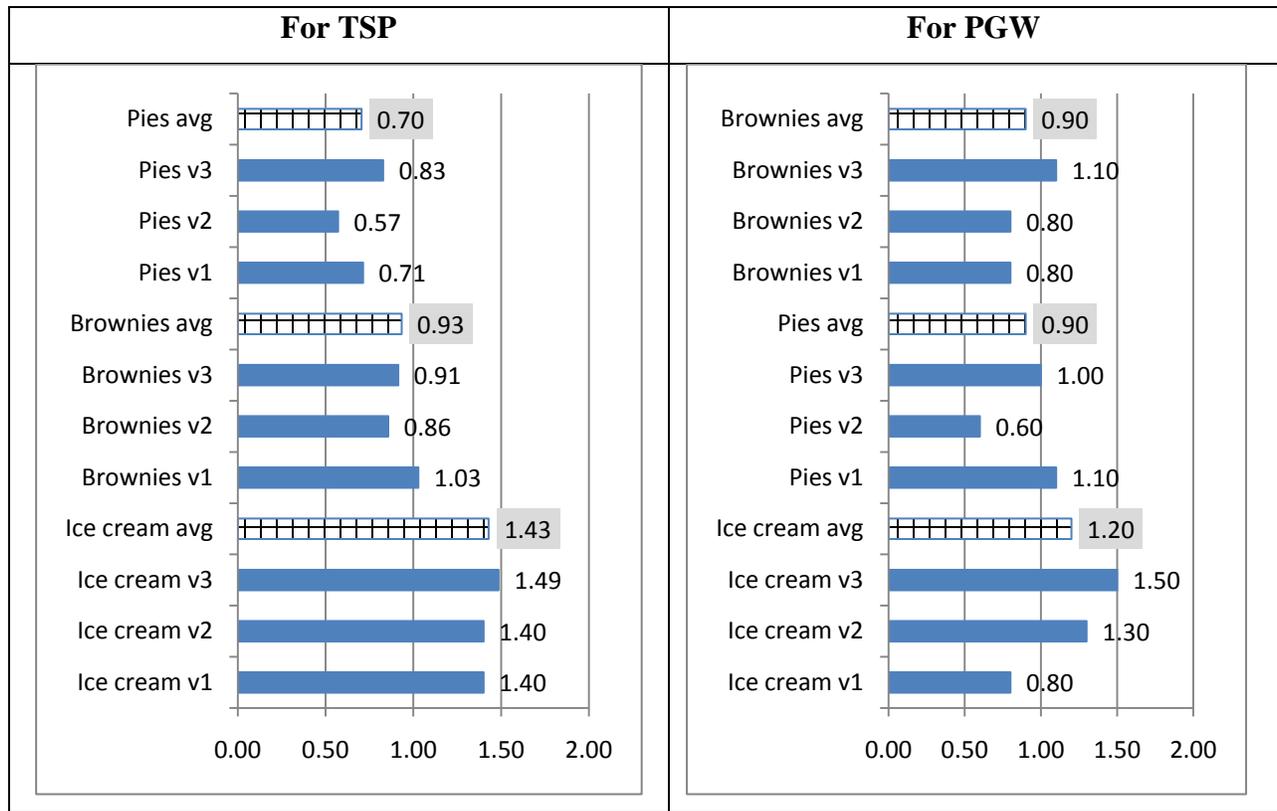


Figure 6: Average consumption of some desserts for TSP & PGW

5.12 Results for questionnaire - Addressing dietary habits of international students

1. Do you cook in your Native country?

Forty six percent participants answered that they were cooking while they were residing in their native country. More than half of the TSP i.e. 54% were not cooking when they were residing in their native country Table 16.

Table 16: Cooking in Native country

Level	Count	Percentage
1 = Yes	16	%46
2 = No	19	%54
Total	35	

Did you skip meals back at home?

Sixty five percent (n=23) of the participants stated that they skipped meals in their native home country Table 17.

Table 17: Skipping meals back at home

Level	Count	Percentage
1 = Never	12	34%
2 = Sometimes	22	63%
3 = Always	1	2%
Total	35	

2. Which is the most frequently skipped meal back at home?

The most frequently skipped meal for international students in their native country was breakfast with a percentage of 62 followed by lunch Table 18.

Table 18: Frequently skipped meal back at home

Level	Count	Percentage
1 = Breakfast	22	62%
2 = Lunch	9	26%
3 = Dinner	3	9%
4 = Combination of two	1	3%
Total	35	

3. Do you cook in the US?

In first visit 77% participants were cooking in the US however this number decreased on the third visit to 69%. This shows that the cooking rate was decreasing in the US. Interestingly we found that 65% participants were influenced by the American food buying / cooking patterns Table 19.

Table 19: Cooking in US

Visit 1			Visit 3		
Level	Count	Percentage	Level	Count	Percentage
1 = Yes	27	77%	1 = Yes	24	69%
2 = No	8	23%	2 = No	11	31%
Total	35		Total	35	

4. How often do you only cook native diet in the US?

Overall there was a decrease of the commitment to cooking a native diet from visit 1 to visit 3. The percentage decrease was 12% for those participants who were always cooking their native diet in visit one to visit three. In addition 6% participants who were mostly cooking their native food in visit 1 chose not to cook it as frequently at visit 3 Table 20.

Table 20: Native diet cooking in US

Visit 1			Visit 3		
Level	Count	Percentage	Level	Count	Percentage
1 = Always	10	29%	1 = Always	6	17%
2 = Mostly	17	49%	2 = Mostly	15	43%
3 = Rarely	5	14%	3 = Rarely	9	26%
4 = never	3	8%	4 = never	5	14%
Total	35		Total	35	

5. Do you skip meals frequently in the US?

Overall participants increased their frequency of skipping meals as 12% more participants started skipping their meals at visit 3 Table 21.

Table 21: Skipping meals in US

Visit 1			Visit 3		
Level	Count	Percentage	Level	Count	Percentage
1 = Yes	13	37%	1 = Yes	17	49%
2 = No	22	63%	2 = No	18	51%
Total	35		Total	35	

6. When you skip a meal do you have a snack instead?

The number of participants who replaced their meals with snacks has increased by 11%. Therefore there was a positive correlation between skipping meals and consuming snacks instead. Generally participants were skipping meals more with an increase of 12% in their third visit when compared to visit one and replacing them with different snacks. 26% increase their consumption of snacks during school hours in the morning and afternoons Table 22.

Table 22: Skipping meals and snacking

Visit 1			Visit 3		
Level	Count	Percentage	Level	Count	Percentage
1 = Yes	21	60%	1 = Yes	25	71%
2 = No	14	40%	2 = No	10	29%
Total	35		Total	35	

7. How often do you have a snack in the morning or in afternoon?

There was an increase of frequency of consuming snacks in the mornings and afternoons during 5 days a week. Twenty six percent participants increased their consumption of snacks during school days Table 23.

Table 23: Snack consumption

Visit 1			Visit 3		
Level	Count	Percentage	Level	Count	Percentage
1 = 7 days a week	4	12%	1 = 7 days a week	2	6%
2 = 5 days a week	7	20%	2 = 5 days a week	16	46%
3 = 2 days a week	19	54%	3 = 2 days a week	12	34%
4 = Never	5	14%	4 = Never	5	14%
Total	35		Total	35	

8. Is dinner the main meal for you in the US?

Twenty percent participants started to consider dinner as their main meal in the US Table 24.

Table 24: Dinner as main meal for participants

Visit 1			Visit 3		
Level	Count	Percentage	Level	Count	Percentage
1 = Yes	20	57%	1 = Yes	27	77%
2 = No	15	43%	2 = No	8	23%
Total	35		Total	35	

9. How frequent do you eat in fast food restaurants?

The number of students, who were consuming fast food, has increased the consumption of fast food slightly from 41% to 46% from one to visit three. It was also noted that the consumption of fast food is the highest during weekends. In addition 31% students were dining and eating in fast food restaurants three times a week and they maintained the similar level during the three visits Table 25.

Table 25: Frequency of eating in fast food restaurants

Visit 1			Visit 3		
Level	Count	Percentage	Level	Count	Percentage
1 = 7 days a week	0	0%	1 = 7 days a week	0	0%
2 = 5 days a week	4	11%	2 = 5 days a week	4	11%
3 = 3 days a week	11	31%	3 = 3 days a week	11	31%
4 = 2 days, Weekends	14	41%	4 = 2 days, Weekends	16	46%
5 = Never	6	17%	5 = Never	4	12%
Total	35		Total	35	

10. What is your level of physical activity after migrating to the US?

Participants who used more physical activity at visit one seemed to reduce their level of physical activity therefore 54% of TSP were doing little or no exercise Table 26.

Table 26: Level of activity by the participants

Visit 1			Visit 3		
Level	Count	Percentage	Level	Count	Percentage
1 = Sedentary	17	49%	1 = Sedentary	19	54%
2 = Moderately	16	45%	2 = Moderately	15	43%
3 = Vigorously	2	6%	3 = Vigorously	1	3%
4 = Extremely	0	0%	4 = Extremely	0	0%
Total	35		Total	35	

Sedentary = office work, getting little or no exercise, moderately = Person running one hour daily, vigorously = Swimming two hours daily, extremely = competitive cyclist

11. What is your level of activity in the US compared to your native country?

Majority of the participants stated that they were less active in the USA as compare to their native country in the first visit with a percentage of 46%. This number kept increasing as more people believed that they were less active in US in their third visit with a percentage of 54% with an increase of 8% Table 27.

Table 27: Comparison of Level of activity in US & native country

Visit 1			Visit 3		
Level	Count	Percentage	Level	Count	Percentage
1 = More active presently	10	29%	1 = More active presently	8	23%
2 = Less active presently	16	46%	2 = Less active presently	19	54%
3 = Same active presently	9	25%	3 = Same active presently	8	23%
Total	35		Total	35	

5.13 Items addressing attitudes / behaviors of international students

12. How much has the American diet influenced your buying / cooking pattern?

A majority believed that they were influenced to a degree by the American diet as 63% participants said “somewhat” when asked about American diet influence on their buying and cooking patterns. Their opinion remained almost same at visit three where 65% participants still believed that they were somewhat getting influenced by the American diet Table 28.

Table 28: Influence of American diet on buying and cooking patterns for TSP

Visit 1			Visit 3		
Level	Count	Percentage	Level	Count	Percentage
1 = Very Much	10	29%	1 = Very Much	10	29%
2 = Somewhat	22	63%	2 = Somewhat	23	65%
3 = Not at all	3	8%	3 = Not at all	2	6%
Total	35		Total	35	

13. How would you describe the portion size served in restaurants in US?

Participant’s opinion regarding the portion size of the serving in US restaurants from visit 1 to visit 3 remains almost the same as 66% participants believed that it is large Table 29.

Table 29: description of serving size in US. Restaurants

Visit 1			Visit 3		
Level	Count	Percentage	Level	Count	Percentage
1 = Small	1	3%	1 = Small	3	8%
2 = just right	11	31%	2 = just right	8	23%
3 = Large	21	60%	3 = Large	23	66%
4 = Overwhelming	2	6%	4 = Overwhelming	1	3%
Total	35		Total	35	

14. Do you believe you are shifting to the American diet?

There was an increase of 12% participants who believed that they were shifting to the American diet from visit one to visit three Table 30.

Table 30: Shifting towards American Diet

Visit 1			Visit 3		
Level	Count	Percentage	Level	Count	Percentage
1 = Yes	19	54%	1 = Yes	23	66%
2 = No	16	46%	2 = No	12	34%
Total	35		Total	35	

15. Do you make sure that you have nutritionally balanced meal?

The confidence level among participants has decreased from visit three to visit one as 12% more participants believe that they were not sure that they had nutritionally balanced meals Table 31.

Table 31: Participants confidence of consuming a nutritionally balanced meal

Visit 1			Visit 3		
Level	Count	Percentage	Level	Count	Percentage
1 = Yes	22	63%	1 = Yes	18	51%
2 = No	13	37%	2 = No	17	49%
Total	35		Total	35	

16. Do you consider the American diet as healthy?

Majority of the participants with a percentage of 89% considers that the American diet is not healthy however 66% of them believed that they were shifting to the American diet by the third visit Table 32.

Table 32: Consideration of American diet as healthy

Level	Count	Percentage
1 = Yes	4	11%
2 = No	31	89%
Total	35	

Chapter 6. Discussion

The United States is a main attraction for many aspiring international students for specialized and higher education. The quality of education and state of the art facilities are a great opportunity not only for professional but also for personal development. In addition, the overall quality of life in America and level of convenience are other positive aspects which attracts students from all over the world. However, international students face many challenges during acculturation which may potentially compromise their well-being.

Virginia Tech is one of the meritorious schools in the US and a home for an increasing number of international students. According to the Cranwell International Student Center, the number of international students increased from 2266 in year 2009 to 2322 in the year 2010. In Fall 2010, a study was conducted to analyze the impact of dietary acculturation on the health status on the recently migrated international students. The Fall semester is the beginning of the academic year, therefore, it was decided to conduct the aforementioned study on newly arrived/enrolled international student. Table 33 show the total number of international students from 20 countries in descending order (undergraduate and graduates) at Virginia Tech in Fall 2010 (from Cranwell International Center website).

Table 33: International students at Virginia Tech Fall 2010 Semester

Country	Number	Country	Number
China	619	Thailand	26
India	483	France	24
South Korea	186	Pakistan	22
Iran	74	Canada	21
Taiwan	49	Brazil	20
Turkey	46	Nepal	18
Germany	42	Mexico	17
Egypt	44	Kuwait	16
Saudi Arabia	40	Italy	13
Bangladesh	29	Jordan	13

The first data collection, visit number 1 conducted in the last week of August and first week of September, was our baseline for parameters such as weight, blood glucose level and blood pressure, calorie count by 24 hr dietary recall, and food frequency questionnaire. V2 took place in mid semester (October the 11th, 12th, 13th and 18th) and V3 occurred towards the end of semester (November the 15th, 16th, and 17th.).

Since weight is an important factor related to health status, we first and foremost analyzed change in weight during the Fall Semester. We found that there was a statistically significant ($p=0.0083$) increase in the weight by 2.79 lbs of the TSP (1.96%) when comparing V3 to V1. Interestingly, out of 35 participants, 10 participants (28.5%; PGW) gained 6 lbs or more during the 11 week testing period with an average of 9 lbs/participant (6% increase). In addition, 6 participants (17%) gained more than 4 lbs but less than 6 lbs, with an average of 4.73 lbs/participant. Only 4 (11.4%) participants had a weight loss of 4 lbs or more.

These findings show that there is a positive trend in the weight gain among the participants since there was marked increase in the weight of around 45.5 % population. Around 43.1% participants showed slight variation in their weight (< 4 lbs). For the first time, these results indicates that recently migrated international students at Virginia Tech have a likelihood to gain weight after residing in the US for 11 weeks. Studies conducted by other groups also showed a positive correlation between weight gain and residing in a new country (Kuo 1996; Papadaki and Scott 2002). If the students were to continue on the same pattern of weight gain during their stay in the US, there is a great probability of shifting their weights to a higher category. This increase in weight is alarming and could indicate a trend if those participants were not more cautious in the future. Gender wise, females ($n=18$) had a significant increase in weight ($p=0.00153$) of 3.99 lbs/person from V3 to V1. However, males ($n=17$) did not have significant differences in the weight from V3 to V1.

Out of the total international students at VT, Chinese students are in the highest number and in the present study we had a similar representation of Chinese in the TSP. The average weight gain for Chinese students was also highly statistically significant ($p=0.00775$). The percent increase for weight for Chinese student was 3.43%. Indian students who were next highest in terms of number at Virginia Tech and also in our study gained 2.36 lbs (2% increase) in their body

weight, albeit not statistically significant. Impressively, Germans (n=4) had weight gain lower than the average of total population indicating they might be more aware and have similar dietary pattern as in their native country. Not surprisingly, it has been shown previously that Europeans have a relatively smooth transition in the US when compared to non-Europeans because of different life styles and eating habits (Constantine and Kwan 2003). Asians (Chinese and Indians) have a different dietary/culinary pattern than that in the US. These changes together with the adaptation to the new environment might have influenced their food intake.

With regards to the Chinese students, there were several factors that may have led to their increase in weight. Firstly, their numbers (n=14) were the largest in our research sample which resulted in a statistically significant data. Secondly, their culinary practices are relatively healthier e.g. stir-frying and steaming being the common mode of cooking in China. However, convenience, and lack of time to cook could have influenced their food choices. Since there was an overall weight gain, we next performed a 24-hr dietary recall on the participants. We found that there was a slight increase in the total calorie intake by V3; however it was not statistically significant. PGW had increased average caloric intake by 4.17% (1673.40 to 1746.3 Cal) from V1 to V3.

As we expected, students underwent gradual process of dietary acculturation. Based on the frequency of intake of the food from the 21-most popular consumed item in the US over last 6-week, it was found that TSP had an increased percentage (4.07%) of frequency of consuming American food items from V1 to V3. Overall, the total population is adapting/or acculturated to American food as indicated by the above finding. It has been reported in previous studies that there is a positive correlation of migration with acculturation to American food items (Bermudez, Falcon et al. 2000; Satia-Abouta, Patterson et al. 2002). Sukalakamala and Brittin (2006) showed that after migrating to the US, Thai students had a significant increase in consumption of 33 American foods. Another study showed that third generation of Japanese population had acculturated to American diet more than their parent generation. These studies support our findings that the acculturation process is inevitable after migrating to a new host country (Sukalakamala and Brittin 2006).

On comparing the frequency of consumption of the most commonly consumed food items in the US, it was found that PGW group had an increased frequency of consuming burgers, mashed potatoes, bagels, french fries, peanut butter, pepperoni, pies, flavored water, meat loaf more than the TSP. However, TSP had a higher consumption of carbonated water, ice cream, mac & cheese, chicken nuggets and hotdogs when compared to PGW. The above mentioned findings show that the PGW group was consuming higher calorie food items which may have contributed in their weight gain.

The consumption of a balanced diet is essential for a healthy life. American diet has been known to be high in carbohydrates, fats and simple sugars and low in fibers (Miller 2005; Neumark-Sztainer 2005; Taylor, Keim et al. 2006; McCracken, Jiles et al. 2007; Sparling 2007; Lee 2008). There is an increasing trend in the consumption and availability of processed foods. With regards to food items high in protein and fat such as meat and high in simple sugars such as dessert, it was observed that the TSP had a lowered frequency of consuming meat loaf and hotdog from V1 to V3. Interestingly, frequencies of consumption of burgers, pepperoni, peanut butter, chicken nuggets, pies, ice cream were observed to have increased from V1 to V3. These results indicate acculturation towards the high calorie American food items. PGW had an increased consumption of burgers, peanut butter, pepperoni, ice cream and brownies from V1 to V3. Impressively, TSP consumption of burgers increased significantly ($p=0.027$) when compared from V1 to V3.

We analyzed the frequency of consumption of food items that are rich in carbohydrate and low in fiber between V1 and V3. Although a marked difference in frequency of consuming food items rich in carbohydrates such as French fries, mac and cheese, pizza, mashed potato was not noted in the TSP from V1 to V3, there was an increased trend in the consumption of bagels and granola bars. On the other hand, PGW had an increased frequency of consuming carbohydrate rich food items like pizza, doughnut and bagels with decreased consumption of mashed potato and mac and cheese. The bagels were the only item found to be significantly increased (0.0149) in the frequency of consumption from V1 to V3 in PGW group. There were no variation in french fries and granola bars consumption from V1 to V3. These results are in agreement with other reports which suggest that the American diet of young adults in the US is rich in carbohydrate and in fat and low in fiber (Taylor, Keim et al. 2006; Lee, Goldstein et al. 2008). This suggests that

international students are starting to develop a preference for eating high carbohydrate, high fat and low fiber diet like their American counterparts. These trends may have an impact on their health status.

Heart disease is one of the leading causes of deaths in the US and diet plays an important role in predisposing an individual to the risk of cardiovascular diseases. Elevated levels of blood pressure is strongly related with weight gain. We measured blood glucose level to test the likelihood of showing early symptoms of diabetes or obesity. Since the duration of study was only 11 week, there was no marked variation in the blood pressure levels of all the participants. Only 13 out of 35 participants showed a slight increase in the systolic blood pressure. Six out of 10 participants in the PGW group showed an increase in their blood pressure levels when compared from V3 to V1. There are chances of misinterpretation of this result due to the error in readings obtained from the Digital Advanced Rest blood pressure monitor and also from personal stress of studies and acculturation as international students who migrate to the United States face many challenges including adjustment to the new environment.

Psycho-social stressors such as academic demands, lack of familiarity with the US customs and culture, and changes in their support system leads to social isolation among international students. The student face several barriers, first and foremost of which is language, leading to a lack of confidence to communicate with the English speakers. The international students need time to adjust to various aspects of education including a new Learning system, accents of the instructors in class and an informal atmosphere. The adjustment process is further complicated by the desire of the students to excel, and meet their families' expectations. The consequences of the anxiety to succeed academically might lead to sleep disorders, eating disorders, fatigue, stomach ailments and headache (Lin 1997). All of the latter mentioned stressors could affect their blood pressure.

We next measured blood glucose levels and found that only 4 out of 35 participants had a slight increase in blood glucose levels, although the levels were within the normal range and the chances of error during performance of this test are limited, most participants were not fasting at the V1 which might have influenced the reading of blood glucose at the V1.

To assess their knowledge and awareness about American diet we asked the participants to fill a questionnaire which included questions related to their eating habits, exercise regimen and knowledge of current dietary guidelines. When asked whether the American diet influenced the cooking and buying pattern, the 65% of the participants believed that they were somewhat influenced by the American food choices. Interestingly, 29% of the participants believed that American diet has influenced their cooking and buying patterns. To assess their level of commitment to their native diet, we asked a question regarding their shift to the American diet. The number of participants who believed that they are losing their commitment to their native diet, and increasing their adaptation to American diet, increased from 54% at V1 to 66% at V3. These findings support our hypothesis that the international students are likely to adapt to the American lifestyle and will shift from their traditional dietary pattern to the host country diet. Dietary acculturation might be detrimental for health which may pose a risk of developing obesity as has been reported previously for different studied population groups such as Latinos, Korean Americans and Japanese American (Perez-Escamilla and Putnik 2007; Pierce, Austin et al. 2007; Lee 2008).

The level of acceptance and adaptation to the American diet may vary by different ethnicities based on the presence and exposure to American-style diet in their native country. For instance, it is possible that the Europeans/Canadians will easily acculturate due to the similarities in the diet and life-style as compared to Asians. Asians may have a different response to the new food choices as they come from different environments and backgrounds. We observed that the Asians, particularly Chinese, showed a significant increase in their weights possibly due to their stronger reaction to the American lifestyle. It is important to note that studying the dietary patterns of international students and collecting information from individuals coming from different ethnicities is a complex phenomenon. This intricate process has to be taken into consideration when interpreting the data. Students coming from countries that are considered to be high socioeconomically can afford to experiment with newer food items; therefore have a greater possibility of consuming more diverse food. Whereas, some students coming from less privileged countries and particularly those who are living on a fixed-limited income and are short on time would rather choose convenient food items in order to save both money and time.

Due to financial burden and lack of time, many international students make their life more convenient by consuming American fast food which may impact on their well being. Many of these international students change their eating habits to a higher carbohydrate and fat diet along with decreased consumption of fruits and vegetables. Many American food chains are now present globally, but the popularity of those chains is high among city-dwellers, younger generations, and college students due to the perceived notion of it being “American”. Therefore, it is more likely that the degree of adaptation to American-diet is easy for those immigrants who have developed this taste of food back home. Eating and dining out is the part of the American culture. International students adopt this habit as a part of their acculturation process. This was also supported in our study, as there was an increase in dining out on weekends from 41% in V1 to 46% in V3.

The change in the portion size is another issue which the internationals have to cope with in the U.S. When participants were asked to describe their opinion on the portion size in the restaurants in the US, 66% in V3 agreed that it is large while 23% said it was just right. Interestingly, around 8% of the participants believed it to be small. The increased frequency of dining out and adapting to the Western dietary practices is strongly associated with the weight gain. Consumption of fast food items which are loaded with calories and fat; larger portion size and the limited knowledge about the nutritional content of the foods available at the restaurants could be considered as the main factors which lead to weight changes and risk of cardiovascular diseases in immigrants.

The knowledge of dietary guidelines from USDA and FDA is strongly related to healthful eating patterns. The lack of awareness of the benefits of healthy eating can affect their health status. Even though, in the present study, our participant acknowledged they were aware that the American diet is not healthy, there was an increased shift towards intake of nutritionally unbalanced diet by the end of the study. Around 63% participants said that they made sure that they have a nutritionally balanced meal at V1 but by visit 3 only 51% were having a balanced meal. When asked about their opinion of American diet, around 89% of the participants believed that the American diet is not healthy while only 11% said that it is healthy. Students who had meal plans were dependent on dining halls so were not sure of the method of cooking and nutritional content.

Participants were asked about their physical activity after migrating to the US. When compared from V1 (49%), at V3 (54%) there was an increase in the percentage of the participants who said that they have a sedentary lifestyle. This could be due to busy class schedule and not having enough time for exercise. Surprisingly, there was an increase in number of participants, from 46% at V1 to 54% at V3, who believed that they have become less active after coming to the US. Additionally, the number of participants who were more active at V1 decreased from 29% to 23% at V3.

Another important aspect will be adjusting to a new cuisine. Many of these newly arrived students have nothing to fall back on, but the warmth of the food they are familiar with. This may be difficult to accomplish due to limited accessibility of ethnic foods. Some of these international students are also inexperienced in cooking and are unfamiliar with terms/names of food items that they originally consumed in native country, making it difficult for them to find them in U.S. Participants were asked if they were cooking in their native country and after arriving in the US. Around 54% of the participants were not cooking in their native countries; the reason might be due to their living arrangements back at their country, where as someone else might be responsible of cooking and preparing meals for them, e.g. some participants could be living with their parents or spouses. Furthermore interestingly the percentage of participants cooking in US decreased from 77% at V1 to 69% at V3, which possibly suggests that they are cooking less and are more dependent on the ready-made food or cooking/buying American-style food.

This was also further confirmed when they were asked about their commitment to cook only native food. There was a decrease in percentage of participants who always cooked native food from 29% at V1 to 17% at V3. Additionally, the percentage of participants who said that they rarely cook native food increased from 14% at V1 to 26% at V3. Moreover, international students might confuse some food items that look the same but are not the ones they are looking for, an example could be that it's easy to confuse plantain with bananas. In addition international students are also paying high prices in order to purchase their ethnic food, yet the quality is not up to their standards. This results in experimenting and trying many foods until they find the closest alternative to their food. From these results, we conclude that the participants are losing their commitment to native diet and are getting accustomed to the American food items.

Eating meals at proper time does affect the metabolism and performance in general. Skipping meal is commonly observed these days due to fast-nature of life. This can also lead to overeating at odd times and increased frequency of munching or snacking. Therefore, we asked participants about their meal frequency and snacking. When asked if they used to skip meal back home, 34% participants never skipped meals while 63% said that they used to skip meals sometimes back home, with the most frequently skipped meal being breakfast (62%). Only 9% skipped dinner and 26% skipped lunch in their native countries. After arriving in the US, the frequency of skipping meal increased from 37% at V1 to 49 % at V3. Additionally, there was an increase in the percentage of participant who was snacking in morning and afternoon more than 5 days a week from 20% in V1 to 46% in V3. This was accompanied in a decrease percentage of participants who were snacking two times a week from 54% at V1 to 34% at V3.

The replacement of the meals with snack increased from V1 to V3 by 11%. Since dinner is considered to be the main meal in the US, the participants were asked whether they had dinner as the main meal after coming to the US. It was found that the percentage of dinner consumption increased from 57% at V1 to 77% at V3. Since after coming to the US in the first 11 weeks, more number of participants are skipping meals with an increase in snacking along with an increase in considering dinner as the main meal. We can assume that the most common time to skip the meal and replace it with snack is either breakfast or lunch. There are chances that skipping meals will result in overeating which may have an impact on the health status of the participants.

At V1 the participant were recently arrived and were not familiar with many items listed in the roster of most common consumed foods in the US. Therefore, we did not detect any acculturation in the first data collection. Since, the second visit was only 6 weeks following the V1, there were no distinct variation in the weights and other parameters including frequency of consumption of American food. However, we detected positive changes in the dietary acculturation in second and more promising at the third data collection. Thus we compared V1 with V3 for all of our tests.

We found that the international student had difficulties in maintaining their native diet. This could be due to several factors including: (i) limited options of stores which sell ethnic foods; (ii)

quality does not meet the expectation of consumer; (iii) ethnic food is relatively more expensive which is also due to monopoly of few businesses in the area; (iv) convenience also influences food choices, e.g. lack of time to cook or conveyance will make the students dependent on frozen foods. We also found that newly arrived students skipped meals and had increased frequency of snack consumption due to school schedules and financial burden.

Chapter 7. Conclusion and Future Directions

This novel study was conducted at the Department of Human Nutrition, Food and Exercise at Virginia Tech and it was a step towards exploring the dietary patterns of the newly arrived international student. The data has improved our current understanding of dietary acculturation of international students at Virginia Tech. These findings have laid a foundation for future research which should focus on making the transition of international students smooth. In future, studies should be more intensive, involving more higher of participants and should be designed for a longer duration in order to detect more conclusive changes and confirm our findings in this present study.

From this study we were able to identify some of the potential areas which should be given importance while planning orientation programs related to adapting to a new country. The orientation programs should be focused on the needs and concerns of the international community. We anticipate that informing the international students about the importance of healthy diet will assist them in choosing a healthier lifestyle. It will be recommended that the international students try to maintain a fine balance of retaining healthy native diet and adapting nutritionally sound American-diet. These steps will help the students to adapt easily and reduce their stress and risk of obesity and hypertension. We can also direct international students by giving them efficient ways to eat and cook healthy on a budget and also inform them about the existing ethnic food stores. This information will be beneficial in creating nutrition education programs for international groups so that they can make informed decisions about adapting to new environment and in making wise nutritionally balanced food choices from Food Guide Pyramid. These programs will help to ease the acculturation process and help them to maintain healthy diet by applying basic nutritional approaches. Overall, these findings could be of aid for dietetics practitioners to have more exposure and awareness to other cultures and their dietary patterns.

The study period in our research was very short comprising only 11 weeks. In addition, the number of participants who initially responded to our invitation (n=42) decreased to n=35 by the end of the data collection, making the sample size not a true representative of the total number of students who enrolled in Virginia Tech in Fall 2010. At the beginning of this study, we had

anticipated that a higher number of subjects to be a part of our study. We did not expect that we will have difficulty in recruiting students to participate. These 2 factors were the main limitations which had an impact on the overall results. Due to short time span of this study, we had only 2 time points of data collection after the our baseline (V1), 5-6 weeks apart as we were not able to observe striking differences in the blood pressure and fasting blood glucose levels. However, weight was the most promising parameter in our research which was significantly increased from V1 to V3. Impressively, it was found to be positively correlated with the dietary acculturation based on the assessing the answers of participants from the questionnaire. As expected the students showed gradual signs of adapting to the American dietary patterns.

Another putative limitation might be that the participants give socially desirable answers rather than being accurate because of the concerns of being judged. This might lead to under reporting in terms of food consumption and frequency. Thus the results may have a degree of biasness.

To summarize, in this research we identified some of the dietary patterns among international community at Virginia Tech, and we were able to highlight the noticeable changes in weights and dietary habits as we found that participants who showed preference towards the consumption of the American diet were more susceptible to gain weight. As the American diet is *stereotyped* as high in fats and carbohydrates, low in fiber along with overwhelming portion size. Although the studied population is well-informed and pursuing higher education, the participants' perception toward portion size might change with time as they get acculturated with the American diet. Additionally, we believe that convenience also play an important role in affecting the food choices and increase the dependence of international students on processed foods. Therefore, they would be prone to consume larger amounts of food, gain weight and will be at a higher risk of diseases. Educating the international students about the advantages of eating healthy balanced diet and familiarizing to a new cuisine and life pattern will aid them in making smart choices. Together, these will make the acculturation process easier and stress-free and will lend a hand for international students to blend well with the American "salad bowl".

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Appendix

Invitation to participate in the research

I am an international graduate student in the department of Human Nutrition Food and Exercise. I came to the US in 2008 to pursue my master's degree with thesis option. My academic adviser for my thesis is Dr. William Barbeau . In order to fulfill the requirement for my degree of Master of Science , I have generate a research study on the

Impact of the American Diet on Newly-Arrived International Students at Virginia Tech.

The focus of my thesis work is on the dietary habits of the international graduate students. The objectives of my research are the following:

1. To assess the changes in the dietary habits of newly enrolled international students single in the U.S. at Virginia Tech in Fall 2010
2. To evaluate the level of acculturation of the international group to American diet, and their degree of commitment to their native diet from Aug-Dec 2010
3. To highlight the noticeable changes in the dietary patterns and its effect on the health status of the international group.

A follow up will be performed with the subjects to assess if there is an overall variation on their dietary consumption. I plan to collect the data for about four months, evaluate and analyze it, and form conclusions on changes in the dietary habits of international students.

In terms of the time line of my research, I plan to collect data during the Fall 2010 semester we plan to analyze the data and finish research by the end Fall 2010. This research is designed to address the key question of dietary acculturation at 3 different time periods: (i) First period would be the baseline-time when the students first arrive on campus for orientation (First half of August); (ii) Second period would be in the middle of semester (Fall Break/First week of October); and (iii) Third period will be around the end of semester (Thanksgiving break). Up on

Agreeing to participate in the study will a receive compensation of \$50 which will be prorated on the 3 time periods.

I would appreciate if you can be a participant in this research. I am looking forward to sharing my research and learning forms this experience.

Sincerely,

Amal Almohanna

Questionnaire addressing dietary habits of international students Demographics

Participant number _____

1. Where did you buy your groceries from when you were in your native country?

- 1) super market
- 2) Fresh Market

2. How often do you cook?

- a) Every day
- b) Three times a week
- c) Weekends
- d) Never

3. Did you cook in your native country?

- a) Yes
- b) No

4. Do you have a kitchen in your living quarters?

- a) Yes
- b) No

5. Do you cook in the US?

- a) Yes
- b) No

6. How often you buy your groceries from American super market?

- 1) Always
- 2) Usually
- 3) Sometimes,
- 4) Rarely,
- 5) Never

7. How often you buy your groceries from International food store in the U.S?

- 1) Always
- 2) Usually
- 3) Sometimes,
- 4) Rarely,
- 5) Never

8. Do you only cook your native food?

- a) Yes
- b) No

9. How often do you only cook your native diet?

- a) Always
- b) Mostly
- c) Rarely
- d) Never

10. How much has the American diet influenced your buying/ cooking patterns?

- a) Very much
- b) Somewhat
- c) Not at all

11. Do you cook American food?

- a) Yes
- b) No

12. How often do you cook American food?

- a) Always
- b) Mostly
- c) Rarely
- d) Never

13. Do you skip meals frequently in the US?

- a) Yes
- b) No

14. How frequently do you dine out?

- a) Daily
- b) Several times a week
- c) Once a week
- d) Once a month
- e) Almost never

15. What type of restaurant would you go to when you eat out?

- a) American fast food
- b) Native cuisine
- c) Other international cuisines

16. Did you skip meals back at home?

- a) Never
- b) Sometimes
- c) Always

17. Which is/are the most frequently skipped meal/s in a day back at home your country?

- a) Breakfast
- b) Lunch
- c) Dinner
- d) Combination of two, please indicate

18. Indicate the reasons for skipping meals back at your home country.

- a) Work/School
- b) Saving time
- c) Financial issues

19. How would you describe the portion size served in the restaurants in the US?

- a) Small
- b) Just right
- c) Large
- d) Overwhelming

20. Do you have breakfast before going to school?

- a) 7 days a week
- b) 5 days a week
- c) 2 days a week
- d) Never

21. How often do you have a snack in the morning/ in the afternoon?

- a) 7days a week
- b) 5days a week
- c) 2 days (Only on weekends)
- d) Never

22. Do you have lunch?

- a) Yes
- b) No

23. When you Skip lunch do you have a snack instead?

- a) Yes
- b) No

24. Is lunch the main meal in your country?

- a) Yes
- b) No

25. Do you still consider it as the main meal in the US?

- a) Yes
- b) No

26. Do you make sure that you have a nutritionally balanced meal?

- a) Yes
- b) No

27. Do you eat dinner?

- a) Yes
- b) No

28. Is dinner a main meal in your native country?

- a) Yes
- b) No

29. Is dinner the main meal now for you in the US?

- a) Yes
- b) No

30. How often do you drink soft drinks?

- a) Always 7days
- b) Frequently 5 days
- c) Sometimes 3 days
- d) Weekends
- e) Never

31. How frequently do you eat at fast food restaurants?

- a) Always 7days
- b) Frequently 5 days
- c) Sometimes 3 days
- d) Weekends
- e) Never

32. Do you think you have healthy eating pattern?

- a) Yes
- b) No

33. Are you concerned about the effects of your dietary pattern on your body weight?

- a) Yes
- b) No

34. Are you concerned about the effects of your dietary pattern on your health status?

- a) Yes
- b) No

35. Do you follow any restrictive diet?

- a) Low- sodium diet
- b) Low-fat diet
- c) Low-fat, Low- carb
- d) Low-fat, High fiber diet
- e) None
- f) Other

36. Do any of these factors influence your food choices?

- a) Availability of native food
- b) Cost
- c) Location of super market
- d) Convenience of food preparation
- e) Food taste
- f) Nutritional facts
- g) Religious affiliation
- h) Other.

37. Do you believe that food is of vital importance in determining your health?

- a) Yes
- b) No

38. How many times in a week do you eat your native food?

- a) Always 7 days
- b) Frequently 5 days
- c) Sometimes 3 days
- d) Weekends
- e) Never

39. How committed are you to consuming your native diet?

- a) Always 7days
- b) Frequently 5 days
- c) Sometimes 3 days
- d) Weekends
- e) Never

40. Do you believe you are shifting to the American diet?

- a) Yes
- b) No

41. Do you think physical activity is important?

- a) Yes
- b) No

42. Why do you think that physical activity is important, please indicate all reasons that apply?

- a) Lose weight
- b) Maintain a healthy life style
- c) Reduce stress
- d) Fun
- e) Other

43. Why don't you exercise, please indicate all reasons that apply?

- a) Busy schedule
- b) Dislike exercising/Boring
- c) Waste of time
- d) Extra burden/ Worry

44. Did you exercise in your native country?

- a) Yes
- b) No

**45. How would you describe the level of your physical activity in your native country?
Examples have been given for assistance.**

- a) Sedentary(Office worker getting little or no exercise)
- b) Moderately active(Person running one hour daily)
- c) Vigorously active(Swimming two hours daily)
- d) Extremely active(Competitive cyclist)

46. Are you currently exercising in the US?

- a) Yes
- b) No

47. What is your level of activity in the US, when compare to your native country?

- a) More active presently
- b) Less active presently
- c) Same active presently

**48. How would you describe the level of your physical activity in the US after migration?
Examples have been given for assistance.**

- a) Sedentary(Office worker getting little or no exercise)
- b) Moderately active(Person running one hour daily)
- c) Vigorously active(Swimming two hours daily)
- d) Extremely active(Competitive cyclist)

49. What kind of physical activity you prefer?

- a) Walking
- b) Running/Jogging
- c) Swimming
- d) Cycling
- e) Other

50. What is your age?

- a) 18-23
- b) 24-29
- c) 30-35
- d) 36-41
- e) 42-older

51. What is the highest level of education you have completed?

- a) High school/GED
- b) Some College
- c) 2-Year College Degree (Associate)
- d) 4-Year College Degree(BA,BS)
- e) Masters Degree
- f) Doctoral Degree

52. What is your total household income, including all earners in your household?

- a) Less than \$10,000
- b) \$10,000-19,000
- c) \$20,000-29,000
- d) \$30,000-39,000
- e) \$40,000- Higher

53. What is your current marital status?

- a) Single,
- b) Married
- c) Separated
- d) Divorced
- e) Widowed

54. What is your religious affiliation?

- a) Protestant Christian
- b) Roman Catholic
- c) Evangelical Christian
- d) Jewish
- e) Muslim
- f) Hindu
- g) Buddhist
- h) Other

55. What is your ethnicity?

- a) European
- b) African
- c) Latino
- d) Asian
- e) South Asian
- f) Middle-Eastern
- g) Other-

56. How long have you been in the US?

- a) One week to three weeks
- b) Four to six weeks
- c) More than two months

57. Rate your level of proficiency in English.

- a) Excellent
- b) Good
- c) Poor

58. Where do you live?

- a) On-campus
- b) Off-campus

59. What is your living arrangement?

- a) Alone
- b) With roommates
- c) Family

60. How much do you spend on groceries every week?

- a) \$30- \$50
- b) \$50-\$100
- c) \$100- \$200
- d) Other

61. How knowledgeable do you consider yourself in terms of healthy food practices?

- a) Very knowledgeable
- b) Knowledgeable
- c) Not knowledgeable

62. Do you consider the American diet healthy?

- a) Yes
- b) No

63. Did you ever have a nutrition class?

- a) Yes
- b) No

64. Are you health cautious in your food choices?

- a) Yes
- b) No**

65. On a scale of 1 to 5, indicate the clarity of the questionnaire. 5 being extremely clear and 1 being extremely unclear.

1 2 3 4 5

TWENTY-FOUR DIETARY RECALLS

PLEASE PROVIDE YOUR detailed dietary consumption during the last 24 hours. Please indicate if the food item was consumed as a meal (breakfast, lunch, or dinner) or a snack. In addition, indicate the method you usually use to cook the food (deep frying; stir frying; grilling; baking; boiling; steaming and others). Please include the quantity also (cup; tablespoon, teaspoon, pieces).

DATE _____

MEAL	FOOD YOU ATE	QUANTITY	METHOD OF COOKING
BREAKFAST			
SNACK			
LUNCH			
SNACK			
DINNER			
SNACK			

FOOD FREQUENCY QUESTIONNAIRE

LIST OF THE MOST CONSUMED FOODS IN THE US

Please choose from the following items provided in the table on the basis of frequency of consumption. For example, if you are eating one apple every day, your total consumption of Apples will be 7 per week, whereas, if you ate one apple several times a week (e.g., 2 times a week), your total consumption for a month will be 8 apples. In addition, please include the quantity (cup; tablespoon, teaspoon, pieces)

Table 1: Please indicate your consumption from these BEVERAGES

Type of Food	Frequency	Quantity
Water	Daily Several times a week Once a week Once a month Never	8 cups or more 5 cups 4 cups or less None
Flavored water	Daily Several times a week Once a week Once a month Never	8 cups or more 5-3 cups 2 cups or less None
Vitamin fortified water	Daily Several times a week Once a week Once a month Never	8 cups or more 5 -3cups 2 cups or less None
Fruit juices	Daily Several times a week Once a week Once a month Never	8 cups or more 5-3 cups 2 cups or less None
Carbonated drinks	Daily Several times a week Once a week Once a month Never	8 cups or more 5 -3cups 2cups or less None
Diet Carbonated drinks	Daily Several times a week Once a week Once a month Never	8 cups or more 5-3 cups 2 cups or less None
Energy drinks	Daily Several times a week Once a week Once a month Never	8 cups or more 5 -3cups 2 cups or less None
Alcoholic drinks	Daily Several times a week Once a week Once a month	8 cups or more 5 -3cups 2cups or less None

	Never	
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Table 2: Please indicate your consumption from these PROTEINS

Type of Food	Frequency	Total Quantity consumed
Beef	Daily Several times a week Once a week Once a month Never	12-16oz 6-12oz 5-4oz 4-2 oz Less than 2 oz None
Pork	Daily Several times a week Once a week Once a month Never	a)12-16oz b) 6-12oz c)5-4oz d) 4-2 oz e)Less than 2 oz f)None
Chicken	Daily Several times a week Once a week Once a month Never	a)12-16oz b) 6-12oz c)5-4oz d) 4-2 oz e)Less than 2 oz f)None
Lamb	Daily Several times a week Once a week Once a month Never	a)12-16oz b) 6-12oz c)5-4oz d) 4-2 oz e)Less than 2 oz f)None
Hot dogs	Daily Several times a week Once a week Once a month Never	4 hot doges 3 hot doges 2 hot doges 1 hot doges None
Beef jerky	Daily Several times a week Once a week Once a month Never	8oz or more 6oz 4oz 2 oz or less None
Pepperoni	Daily Several times a week Once a week Once a month Never	a) 8oz or more 6oz 4oz 2 oz or less None
Burgers	Daily Several times a week Once a week Once a month Never	8 burgers 6 burgess 4 burgers 2 burgers None
Steak	Daily Several times a week Once a week Once a month Never	12-16oz 6-12 oz 5-4oz 4-2 oz Less than 2 oz None

Meat loaf	Daily Several times a week Once a week Once a month Never	12-16oz 6-12oz 5-4oz 4-2 oz Less than 2 oz None
Bacon	Daily Several times a week Once a week Once a month Never	8oz or more 6 oz 4 oz 2 oz or less None
Chicken nuggets	Daily Several times a week Once a week Once a month Never	25 pieces or more 20_15 pieces 10 – 5 pieces None
fish	Daily Several times a week Once a week Once a month Never	8oz or more 6 oz 4 oz 2 oz or less None
shrimps	Daily Several times a week Once a week Once a month Never	8oz or more 6 oz 4 oz 2 oz or less None
clams	Daily Several times a week Once a week Once a month Never	20 pieces 15_ 10 pieces 5 pieces or less None
lobster	Daily Several times a week Once a week Once a month Never	8oz or more 6 oz 4 oz 2 oz or less None
EGGS	Daily Several times a week Once a week Once a month Never	20 pieces 15_ 10 pieces 5 pieces or less None
Egg whites	Daily Several times a week Once a week Once a month Never	4 cup or more 2 cup 1 cup ½ cup Few Table spoons None
Green beans	Daily Several times a week Once a week Once a month Never	4 cup or more 2 cup 1 cup ½ cup None
Lima beans	Daily Several times a week	4 cup or more 2 cup

	Once a week Once a month Never	1 cup ½ cup None
Kidney beans	Daily Several times a week Once a week Once a month Never	4 cup or more 2 cup 1 cup ½ cup None
Nuts	Daily Several times a week Once a week Once a month Never	4 cup or more 2 cup 1 cup ½ cup Few Table spoons None
Peanut butter	Daily Several times a week Once a week Once a month Never	2 jar 1jar ½ jar 4 Tbs 2 Tbs None

Table 3: Please indicate your consumption from these FATS

Type of Food	Frequency	Quantity
French fries	Daily Several times a week Once a week Once a month Never	Half a cup One cup Four cups Five or more 1
Fried fish	Daily Several times a week Once a week Once a month Never	25 pieces or more 20-15 pieces 20_15 pieces 10 – 5 pieces None
Butter or margarine	Daily Several times a week Once a week Once a month Never	7 Tbs or more 2- 3 Tbs One TBS or less None
Clarified butter/Ghee	Daily Several times a week Once a week Once a month Never	7 Tbs or more 2-3 Tbs One TBS or less None
Lard in cooking	Daily Several times a week Once a week Once a month Never	7 Tbs or more 2-3 Tbs One TBS or less None
Mayonnaise	Daily Several times a week Once a week Once a month Never	7 Tbs or more 2-3 Tbs One Tbs None
Salad dressing	Daily Several times a week Once a week	7 Tbs or more 2-3 Tbs One TBS or less

	Once a month Never	None
Sour cream	Daily Several times a week Once a week Once a month Never	One jar 7 Tbs or more 2_3 Tbs One Tbs or less None

Table 4: Please indicate your consumption from these GRAINS

Type of Food	Frequency	Quantity
Whole grain/ whole wheat bread	Daily Several times a week Once a week Once a month Never	A loaf or more ½ a loaf 6 -4 slice 2-1 slice None
Cereal	Daily Several times a week Once a week Once a month Never	4 cup or more 2 cup 1 cup None
Oat meal	Daily Several times a week Once a week Once a month Never	4 cup or more 2 cup 1 cup None
Pancakes/waffles	Daily Several times a week Once a week Once a month Never	6 or more 4-3 2or less None
Popcorn	Daily Several times a week Once a week Once a month Never	4 cup or more 2 cup 1 cup None
Muffins	Daily Several times a week Once a week Once a month Never	7 – 5 muffins or more 4- 2 muffins 1 muffins or less None
Doughnuts	Daily Several times a week Once a week Once a month Never	7 – 5 doughnuts or more 4- 2 doughnuts 1 doughnuts or less None
Mac & cheese	Daily Several times a week Once a week Once a month Never	a) 7-5 cup or more 4-2cup 1 cup or less None
Pasta with meat balls	Daily Several times a week Once a week Once a month Never	a) 7-5 cup or more 4-2cup 1 cup or less None
Pasta with Alfredo sauce	Daily Several times a week	a) 7-5 cup or more 4-2cup

	Once a week Once a month Never	1 cup or less None
Baked potatoes	Daily Several times a week Once a week Once a month Never	7- 6 medium potato or more 5-4 potatoes 3-2 potatoes 1 or less None
Mashed potatoes	Daily Several times a week Once a week Once a month Never	a) 7-5 cup or more 4-2cup 1 cup or less None
Pizza	Daily Several times a week Once a week Once a month Never	2 slices or less 3 or 4 slices Half a pizza One medium pizza One large pizza Two large pizzas or more None
Pretzels	Daily Several times a week Once a week Once a month Never	7-5 cup or more 4-2cup 1 cup or less None
Bagels	Daily Several times a week Once a week Once a month Never	7 – 5 bagels or more 4-3 bagels 2-1 bagels None
Granola bars	Daily Several times a week Once a week Once a month Never	7 or more 6-4 3-1 None

Table 5: Please indicate your consumption from these VEGETABLES

Type of Food	Frequency	Quantity
Broccoli	Daily Several times a week Once a week Once a month Never	7-5 cup or more 4-2cup 1 cup or less None
Spinach	Daily Several times a week Once a week Once a month Never	7-5 cup or more 4-2 cup 1 cup or less None
Corn	Daily Several times a week Once a week Once a month Never	7-5 cup or more 4-2cup 1 cup or less None
Asparagus	Daily Several times a week Once a week Once a month Never	7-5 cup or more 4-2cup 1 cup or less None

Celery	Daily Several times a week Once a week Once a month Never	7-5 cup or more 4-2 cup 1 cup or less None
Green leafy vegetables	Daily Several times a week Once a week Once a month Never	7-5 cup or more 4-2 cup 1 cup or less None

Table 6: Please indicate your consumption from these FRUIT

Type of Food	Frequency	Quantity
Apples	Daily Several times a week Once a week Once a month Never	7- 5 apples or more 4-3 apples 2-1 apples None
Oranges	Daily Several times a week Once a week Once a month Never	7- 5 or more 4-3 2-1 apples None
Dry fruit	Daily Several times a week Once a week Once a month Never	7- 5 cup or more 4-3 cup 2-1 cup ½ cup or less None

Table 7: Please indicate your consumption from these DAIRY

Type of Food	Frequency	Quantity
Organic milk	Daily Several times a week Once a week Once a month Never	1 gallon or more 7- 5 cup or more 4-3 cup 2-1 cup ½ cup or less None
Cheese	Daily Several times a week Once a week Once a month Never	7- 5 cup or more 4-3 cup 2-1 cup ½ cup or less None
Yogurt	Daily Several times a week Once a week Once a month Never	7- 5 cup or more 4-3 cup 2-1 cup ½ cup or less None
Ice cream	Daily Several times a week Once a week Once a month Never	7- 5 cup or more 4-3 cup 2-1 cup ½ cup or less None

Table 8: Please indicate your consumption from these DESSERTS

Type of Food	Frequency	Quantity
Cakes	Daily Several times a week Once a week Once a month Never	One cake Half a cake 2 or 3 slices One slice None
Pies	Daily Several times a week Once a week Once a month Never	One pie ½ PIE 3-2 SLICES 1 SLICE or less None
Brownies	Daily Several times a week Once a week Once a month Never	7 slices or more 6-5 slices 4-2 slices One or less None
Fudge	Daily Several times a week Once a week Once a month Never	7 slices more 6-5 slices 4-2 slices One or less None
Cheese cakes	Daily Several times a week Once a week Once a month Never	7 slices more 6-5 slices 4-2 slices One or less None
Puddings	Daily Several times a week Once a week Once a month Never	7 slices more 6-5 cup 4-2 cup One or less None
Chocolate bars	Daily Several times a week Once a week Once a month Never	7 slices more 6-5 bar 4-2 bare One or less None