INVESTIGATION OF ACCULTURATION CHANGES IN FOOD INTAKE OF TAIWANESE STUDENTS ATTENDING THE UNIVERSITY OF WISCONSIN-STOUT

by

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ABSTRACT

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Dietary acculturation is one of the many behavioral consequences of immigration. An investigation of the food habit changes of Chinese persons living in Lincoln, Nebraska reported that the longer the Chinese had lived in this country, the more changes in food habits they had made (Yang and Fox 1979). Although there are several studies (Wenkam and Wolff 1970; Yang and Fox 1979; Buell and Dunn 1965; Yano et al. 1978; Nomura et al. 1990; Lewis and Glaspy 1975) which have reported on changes in dietary patterns among different immigrant groups, limited research data on dietary habits of Taiwanese students living in the United States are available. The purpose of this study was to identify if there was a difference of dietary nutrient intake before and after Taiwanese students came to the United States.

Fifteen Taiwanese students enrolled at the University of Wisconsin-Stout participated in this study. The participants were interviewed two times. In the first interview, students completed the food frequency questionnaire about their food intake since they came to the United States and the one day 24-hour recall. In the second interview, the participants completed the same food frequency questionnaire about their food intake in Taiwan before they came to the United States.

During both interview sessions, food pictures, measuring cups and spoons were used to collect the dietary data.

The nutrient composition of the 24-hour recall and food frequency questionnaires were analyzed by the Food Processor Plus program. Paired-samples t test was used to compare the nutrient intakes and percentages of the RDA for the nutrients. One comparison using the t-test was that of the nutrients calculated from the 24-hour recall in the United States to the nutrients calculated from the food frequency questionnaire of food consumed in the United States. A second t-test was used to compare the nutrients calculated from the food frequency questionnaire of foods consumed in the United States to the values obtained from the food frequency questionnaire of food consumed in Taiwan. The third comparison was of the nutrient intake calculated from the 24-hour recall in the United States to the nutrient intake as calculated from the food frequency questionnaire of food consumed in Taiwan.

This study observed that there were significant decreases in the intake in protein, thiamin, vitamin B6, vitamin B12 and vitamin E of students attending the University of Wisconsin-Stout in the United States. In the comparison of the United States food frequency questionnaire to the Taiwan food frequency questionnaire, calories, carbohydrate, fat, cholesterol, vitamin A, riboflavin, vitamin C, calcium, and iron did not show significant differences. Compared to the percentage of the United States recommended dietary allowances; both vitamin E and calcium are well below the RDA.

Our observations can help dietitians to understand the change in nutrient intake that occurs in young Asians attending United States universities. The dietitian can use this information to plan their nutrition education on how to improve the calcium intake of Asian students who experience

lactose-intolerance and have a low calcium intake as well as increasing vitamin E in the diet. This information may assist the dietitian to provide nutrition counseling to their Asian clients.

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CHAPTER ONE

INTRODUCTION

Dietary acculturation is one of the many behavioral consequences of immigration. New food use patterns develop through the rejection of traditional foods and acceptance of culturally new foods. The impact of this process on health is related to the balance between nutritionally sound and nutritional questionable food use changes (Pan et al. 1999).

Since the middle of the nineteenth century, Chinese people have been coming to the United States and entering its institutions of higher learning to pursue academic degrees. While they are learning a new language and adapting to different types of people, food is in a unique position that both links the students with their mother culture and provides a chance for relaxation and enjoyment (Yang and Fox 1979).

Studies of Japanese immigrant families in Hawaii illustrate dramatic changes of food habits. From a predominantly high - carbohydrate, rice and plant food diet, the food pattern of the Japanese immigrant families in Hawaii was changed to a "cosmopolitan" diet consisting of high-protein and high fat foods. The socio-cultural forces which impacted the change in dietary habits of these Japanese immigrants included the desire for higher social status; disorganization of the traditional family, and released customary control over certain foods. The most decisive factor is the changing attitude of the second generation toward Japanese foods and traditions in general. The effect of this dietary change has been a reduction in death from beriberi, increased longevity, and an increase in the stature of the *Nisei.* Unfortunately, the dental caries rate and incidence of coronary heart disease has increased. It is evident that the immigrant Japanese families have adopted western foods as they have adopted western ways, which appears to have had some undesirable as well as desirable effects on health (Wenkam and Wolff 1970).

Among the environmental factors, dietary changes are considered to be one of the components that might increase risk for cancer (He et al. 1996). The typical Asian diet can be characterized as low fat, especially low in animal fat, and higher in fiber than a typical U.S. western diet (Yu et al. 1991; Guldan et al. 1991). During the last 19-20 years, several Asian areas have been undergoing industrialization and rapid economic change. Concurrent with this industrialization is a westernization of the dietary pattern and increases in chronic diseases associated with western diets (Lee et al. 1989; Kodama et al. 1991).

An investigation of the food habit changes of Chinese persons living in Lincoln, Nebraska reported that, the longer the Chinese had lived in this country, the more changes in food habits they had made. Especially when the people had an American food experience before coming to the United States (Yang and Fox 1979). In this study, significant changes in the lunch pattern were clearly observed. A traditional Chinese lunch features rice and several dishes of meat and vegetables. A large proportion of the subjects reported eating an American lunch because they often ate outside of the home at lunchtime. This study also indicated that American foods were usually not accepted and eaten in their natural style. Rather, they were modified according to the flavor and texture preferences of the Chinese and accepted as a new, "Chinese-like" food. The authors indicated that besides incorporation of American foods into the diet and the decreased consumption of Chinese foods, their study showed that a continuous process of food habit change is occurring in this group of Chinese immigrants. The authors anticipated that the longer the immigrants remained in the United States and the greater their exposure to American foods, the more American food habits they adopted (Yang and Fox 1979).

Although there are several studies, which have reported on changes in dietary patterns among different immigrant groups, limited research data on dietary habits of Taiwanese students

living in the United States are available. An understanding of dietary patterns of Taiwanese students with cultural backgrounds that are different from their American counterparts is important in the development of nutrition education programs for Taiwanese immigrants (Pan et al. 1999). Also, it would be of value to compare the nutritional intake of those whose food habits do change with those that retain the more traditional food habits.

1. Statement of the Problem

The purpose of this study is to identify the changes in food intake of Taiwanese students at the University of Wisconsin-Stout compared to their food intake before they came to United States. Nutrients, which will be investigated, include calories, carbohydrate, fat, protein, vitamin A, thiamin, riboflavin, vitamin C, calcium, and iron.

2. Objectives of the Study

1) Collect food intake data using the 24-Hour Recall and Food Frequency Questionnaires.

2) Identify changes in dietary habits of Taiwanese students as a result of living in Wisconsin.

3) To analyze the dietary nutrient intake of Taiwanese students before and after immigration to the United States.

It is anticipated that the findings of this study will help the Taiwanese student immigrants know what kind of food they should increase or decrease to maintain their health status. Also, the study will provide the dietetic professions more accurate information about the dietary changes that occur as a result of the Taiwanese immigration for development of nutrition education programs.

CHAPTER TWO

REVIEW OF THE LITERATURE

The role of immigration as a factor for changing food intake and altering the risk of certain diseases and nutritional status of Chinese people has received limited attention. This review will discuss the nutritional status of Chinese people in Taiwan, illustrate how nutrition status changes as cultures move as reported in migrant epidemiological and food intake studies, highlight dietary beliefs of Chinese, and will describe the nutritional status of people living in China.

1. Nutritional status of Chinese people (Taiwan)

Assessing food patterns and nutrition profiles can obtain information to control chronic diseases (Tian et al. 1995). Chinese adolescents have experienced an improvement of diet and nutritional status. Overweight has emerged as a problem associated with young, high-income and urban adolescents, but the prevalence of obesity (4%) is quite low compared with developed countries. Chinese adolescents' energy and protein intakes were adequate compared with the American RDA (Wang, Popkin and Zhai 1998).

Two surveys about the Chinese diet conducted during 1990, report that most of the nutrient intakes are close or equal to their corresponding recommended daily allowances (Tian et al. 1995; Chen and Gao 1993). Both the total energy intake (2203 kcal) and the proportions contributed by protein, fat, and carbohydrate meet the current Chinese RDAs (Appendix A). The intake of essential amino acids all exceeded the Chinese RDA, and their proportions were generally consistent with the Chinese RDA recommended pattern. The dietary fat intake has been increasing significantly in the Chinese diet, and the proportion of animal fat has reached 53% of the total fat intake. The total saturated, total monounsaturated, total polyunsaturated fatty acid ratio

was 1.0: 1.5: 1.0, respectively. The intakes of thiamin and riboflavin were below the RDA. Retinol intakes were low. Most of the retinol (equivalent) intakes were from carotenoids. The average intake of total tocopherol was 89% of the RDA. The intakes of calcium, zinc, and potassium were insufficient, and intakes of selenium and magnesium were a little low. The intakes of iron, copper, manganese, sodium, and phosphorus were adequate. High sodium and low potassium intake is a traditional problem in the Chinese diet.

Among the animal foods, pork remains the most common and least expensive form of meat, contributing more than 90% of China's total meat production exceeding poultry and fish (Kantha 1990). Another study reported that lunch was the most substantial meal of the day for Chinese working women in Taiwan (Shimbo et al. 1997). When comparisons were made to the recommended dietary allowance (RDA) for these Taiwanese women, the insufficiency ratios were more than 50% for minerals (i.e., iron and calcium) and all vitamins (except for vitamin C). Excess in the lipid energy ratio (> 30%) was observed in 60% of the working women. These data illustrate that integrated nutrition intervention is needed to prevent insufficient intake of some nutrients and control dietary risk factors such as high fat intake, which is related to chronic diseases (Tian et al. 1995).

2. How Nutrition Status Changes as Cultures Migrate

----Migrant Epidemiological Studies

International migration studies show that the movement of population groups from one society to another provides a special opportunity to evaluate change in risk factors among persons sharing the same genetic and cultural background. Studies of Japanese immigrant families in Hawaii stand out as illustrating a dramatic change of food habits. From a predominantly high-carbohydrate, rice and plant food diet, the food pattern of the Japanese immigrant family in

Hawaii was changed to a "cosmopolitan" diet consisting of high-protein and high-fat foods. The most conspicuous dietary change in these families was in the breakfast menu. The American breakfast replaced the rice, soup, and pickled vegetable meal of the traditional Japanese. The socio-cultural factors which impacted the changes in dietary habits included the desire for higher social status; disorganization of the traditional family, and released customary control over certain foods. The most decisive factor was the changing attitude of the second generation toward Japanese foods and traditions in general. The effect of this change has been a reduction in death from beriberi, increased longevity, and an increase in the stature of the Japanese. Unfortunately, the dental caries rate and incidence of coronary heart disease has increased. Thus, the immigrant Japanese have adopted western foods as they have adopted western ways, which appears to have had some undesirable as well as desirable effects on health (Wenkam and Wolff 1970).

Studies of immigrants from Japan to the United States show that the risk of colon cancer, which is extremely common in California, but rare in Japan, approaches that of white men in California with migration (Buell and Dunn 1965). In contrast, the risk of stomach and liver cancer is much higher in native Japanese than among whites in the United States as well as among Japanese men who migrated to California. Risks of mortality from these two cancers among the sons of Japanese immigrants are still lower (Yano et al. 1978). These findings strongly suggest that the occurrence of these cancers is largely determined by environmental rather than by genetic factors. Among the environmental factors, dietary changes are considered to be one of the components that significantly increase the risk for cancer (Nomura et al. 1990).

A study conducted with college-educated Filipino women who had migrated from the Philippines to Los Angeles within the past ten years indicated that the most significant change in food habits was the addition of milk to the diet. Other changes included consumption of more

meat, fruits, fresh vegetables (as in salads), and juices; less starchy foods; and fewer snacks. Ease of preparation of food, nutritional value of the foods, and the costs of the foods are the factors that most influenced their food choices. These subjects ate three times more sweet snacks in the U.S. than they did in the Philippines. This study illustrates that when Filipino women migrate to the U.S., ethnic foods are modified but not abandoned. Changes of the food habits in the Filipino women appear to be for the better, nutritionally (Lewis and Glaspy 1975).

3. Studies on the Dietary Patterns of Chinese Immigrants

The diet of the typical Asian can be characterized as low fat, especially low in animal fat, and higher in fiber than a typical U.S. western diet (Yu et al. 1991, Guldan et al. 1991). During the last 19-20 years, several Asian areas have been undergoing industrialization and rapid economic change. Concurrent with this industrialization is a westernization of the dietary pattern (Lee et al. 1989, Kodama et al. 1991).

Since the middle of the nineteenth century, Chinese people have been coming to the United States and entering its institutions of higher learning to pursue academic degrees. While they are learning a new language and adapting to different types of people, food is in a unique position that both links them with their mother culture and provides a chance for total relaxation and enjoyment. A study which investigated the changes in food habits of Chinese persons moving to Lincoln, Nebraska reported that, the longer the Chinese had lived in this country, the more changes in food habits they had made, especially when the people had American food experience before coming to the United States. In this study, changes in the lunch pattern were clearly

observed. A traditional Chinese lunch features rice and several dishes of meat and vegetables. A larger proportion of the subjects reporting eating an American lunch because they often ate outside of the home for this meal. This study also indicated that American foods were usually not accepted and eaten in their natural style by these immigrants. Rather, these foods were modified according to the flavor and texture preferences of the Chinese and accepted as a new "Chinese-like" food. Incorporation of the American foods into the diet and the decreased consumption of Chinese foods show that a continuous process of changing food habits was going on in this group of Chinese. The authors anticipated that the longer that the Chinese immigrants remained in the United States and the greater their exposure to American foods, the more American food habits they will adopt (Yang and Fox 1979).

Another study also found that Asian students changed their eating patterns after living in the United States (Pan et al. 1999). They observed that most of the students skipped their breakfast, increased frequency of consumption of salty and sweet snack items, and decreased the frequency of consumption of vegetables, which could have undesirable long-term health effects on the students. Significant increases were also noted in consumption of fats, sweets, dairy products, and fruits. Significant decreases were noted in the consumption of meat/meat alternatives and vegetables after immigrating to the United States. The authors hypothesized that possible explanations for the dietary changes included an increase in the number of men preparing food, limited time to prepare traditional dishes because of busy school schedules, financial constraints because of the limited amount of money to spend on food, and increased availability of other American-style foods.

4. Dietary Beliefs of Chinese

Many Chinese people living in the United States continue to observe diet and health practices from their mother country. Chinese folk beliefs propose that elemental forces control the universe and pervade all aspects of human endeavor (Chang 1974). Two opposing components, the Yin and the Yang, regulate the universe. The Yin component includes female, darkness, cold, and emptiness. An excess of Yin causes the person to be prone to infection, gastric problems and to be unusually anxious. The Yang component encompasses male, light, warmth, and fullness. Too many “Yangs” are believed to cause the person to become dehydrated, feverish and become irritable and edgy. The common ginger root is considered a "hot" food to prevent and treat nausea and dyspepsia. And the common "cold" food such as white turnips, seaweed and bean spouts must be eaten in limited amounts. Appropriate herbal or root medicine is also given to help counter many illnesses. Chinese medication is thus largely oral, consisting of a balanced diet of "hot" and "cold" foods, and of herbs and roots for their "heating" and "cooling" effect (Chang 1974 and Chan 1995). Some symbolic foods are given for medical reasons. For example, relatives may feed a person who has heart disease soup that contains the heart of a pig. Western medicine would perceive this as potentially dangerous because of its high cholesterol content, contraindicated in such a condition (Chan 1995).

The dietary preference for an ordinary Chinese meal consists of cooked rice and *sung*, which literally means "topping for rice". Sung may include seafood, meat or vegetable dishes. Rice is the staple of the traditional diet. The older generation believes that rice is the only form of real energy and vitality, asserting that a meal without rice just isn't a meal. Rice can be ground into flour and made into noodles, cakes and other delicacies. Because of the history of unsanitary conditions in China and Hong Kong, vegetables are very rarely taken raw. As a result, few Chinese people eat vegetable salads. Vegetables are cooked, preferably on their own or mixed

with meat, or as an ingredient in a soup. Some older Chinese who have been used to having to boil their drinking water for sanitary reasons often avoid cold water (Chan 1995).

The Chinese like all kinds of seafood and meats. This ranges from fish and chicken, to sea cucumber, abalone and internal organs. Unlike the Japanese culture, raw meat of any source is thought to cause ill health, and is avoided. All meal is cooked thoroughly before being eaten. Many elderly Chinese people have not yet acquired a liking for the taste of cheesy and creamy foods. Because many Asians are lactose intolerant, it might be expected that the elderly Chinese exhibit a low frequency of consumption of milk (Chau et al. 1990).

It is common knowledge that the preparation of Chinese food requires the use of soy sauce (Chang 1974). The main herbal flavorings, which the Chinese use, are star anise, coriander, nutmeg, ginger, garlic, spring onions, and soybean ferments. Dried beans and nuts, salad and preserved vegetables, fish and shellfish are commonly eaten. There are relatively few concentrated sweets in the Chinese diet (Chan 1995).

Chinese people have a strong preference for home cooking. It is believed that drinking the soup can clear the system and promote a speedy recovery, especially after surgery. Other drinks include herbal teas made from dried flowers or grasses (such as chrysanthemum), which are believed to have a "cooling" effect on the body (Chan 1995). For Chinese people, food forms the foundation of their philosophy to life and is believed to give physical, social and spiritual benefits. A good diet is regarded as essential for good health (McAllister and Farguhar 1992).

5. The Health Risks Faced by Chinese Immigrants

The epidemiological studies dealing with immigrant or indigenous populations in transition implicate dietary change as one factor in the etiology of cardiovascular disease, obesity, cancer and periodontal disease. Food pattern changes, especially those involving increased use of

processed foods, and high in refined sugars and fat have been implicated as risk factors for these diseases in many groups. Processed and high fat foods often substitute for nutrient rich traditional foods (Hrboticky and Krondl 1985). Environmental factors are important determinants of serum lipid levels in Chinese (He et al. 1996).

Fang, Madhavan and Alderman (1996) reported that the New York Chinese had higher death rates for nasopharyngeal cancer than either New York City whites or the Chinese in China. Stomach and liver cancer death rates in New York Chinese fell between those in China and New York City whites. Cancer rates in immigrant populations are frequently found to be intermediate between the country of origin and the adopted country. However, the rates of esophagus, colon, and rectum cancers were closer to those of New York City whites. This finding provides additional support for the concept that many cancers originate with and can be modified by environmental factors when cultures migrate (Stellman and Wang 1994).

The incidence of breast cancer varies widely among countries, with rates consistently higher in western countries than in Asia. There are numerous studies which have demonstrated that, when Chinese and other Asian women migrate to the United States, their risk of breast cancer rises over several generations and approaches that in U.S. whites. Overall, Asian-American women born in the West had a risk of breast cancer 60% higher than those born in the East. On the basis of these international comparisons and migrant studies, modifiable exposures related to lifestyle or environment are thought to play a major role in the etiology of breast cancer. The specific causal factors, which are related to diet, need to be investigated. Exposure to western lifestyles appears to have a substantial impact on breast cancer risk in Asian migrants to the United States during their lifetime (Ziegler et al. 1993).

The western lifestyle (high caloric intake, physical inactivity, obesity, smoking, and drinking) associated with the colorectal cancer has been investigated. Findings suggest that a high-energy intake, large body mass, and physical inactivity independently increase risk of this disease and that a nutritional imbalance, similar to the one involved in diabetes, may lead to colorectal cancer (Le Marchand et al. 1997).

6. Chinese People Dietary Survey----Which Nutrients Have Low Intakes

The availability of various foods has increased thanks to rapid economic development in China in recent years. The incidence of cardiovascular disease, cerebrovascular disease and cancer, has also risen significantly. Mortality from cerebrovascular and cardiovascular diseases and cancer accounted for 73% of total deaths in Tianjin in 1989. Tian et al (1995) found that this population has low intakes of vitamin A, calcium, riboflavin, and zinc. Because of their high intake of sodium, their sodium: potassium ratio was very high. Cholesterol intake was much higher among the urban people. The study suggests that integrated nutrition intervention is needed to prevent insufficient intake of some nutrients and control dietary risk factors related to chronic diseases. The nutrient content of some common Chinese foods are presented in Table 1.

Table 1. Nutrient Content of Chinese Foods

Food items (*the nutrient analysis is based on the 100 g)*	Calories (Cal)	Protein (g)	Fat (g)	Calcium (mg)	iron (mg)	**Vitamin**			
						A (I.U.)	B_1 (mg)	B_2 (mg)	C (mg)
Bread/cereal/grain/starches									
Brown rice	340	6.7	2.0	21	1.5	0	0.30	0.05	4.6
Chinese noodles	131	1.8	1.0	19	1.2	0	0.01	+	0.4
Dasheen	75	1.5	0.2	34	1.0	0	0.08	0.04	8
Gluten, fried	114	17.9	0.2	11	1.0	0	0.03	0.02	0.8
Bread/cereal/grain/starches									
Steamed bread	247	8.1	1.2	21	0.4	0	0.05	0.02	_

White rice	354	6.5	0.5	15	0.6	0	0.11	0.04	1.4
Legumes/beans/seeds and nuts									
Tofu	65	6.4	4.2	91	1.3	0	0.07	0.02	0
Soybean, fresh	132	11.2	6.4	50	4.6	+	0.59	0.14	8
Meat and poultry products									
Dumping(pork inside)	227	8.4	11.4	18	0.7	10.00	0.14	0.11	0.4
Ham	524	19.0	49.0	21	3.1	0	0.31	0.13	0
Liver(chicken, pork)	129	20.0	4.0	10	10.2	15000	0.4	2.7	11
Meat ball	231	16.5	18.5	10	0.6	13.0	0.29	0.12	_
Pig's blood, cooked	18	4.0	0.1	7	12.6	200	0.06	0.05	0
Pig's feet	223	21.7	14.4	55	1.0	15.0	0.16	0.15	1.0
Pig's intestine	68	10.4	2.5	6	1.5	_	0.11	0.10	0
Pork or fish dried and crushed	352	53.6	10.4	53	10.5	_	0.25	0.27	0
Pork fat	823	3.0	89.0	1	0.2	_	0.19	0.04	0
Pork sausage	359	36.6	18.7	28	3.9	_	0.82	0.31	0
Fish and marine products									
Kelp	91.6	0.2	5.3	146	0.6	180	0.02	0.01	2
Food items (*the nutrient analysis is based on the 100 g)*	Calories (Cal)	Protein (g)	Fat (g)	Calcium (mg)	Iron (mg)	**Vitamin** A (I.U.)	B_1 (mg)	B_2 (mg)	C (mg)
Fish and marine products									
Laver dried	10.3	0.8	42.0	850	98.9	_	0.34	0.38	_
Vegetables									
Garland chrysanthemum	12	1.6	0.1	53	2.3	7500	0.05	0.08	14
Lily flower, dried	254	8.5	2.5	340	14.0	7000	0.16	0.71	_
Mushrooms, Chinese	129	15.2	1.7	125	9.0	0	0.56	2.11	0
Mango	40	0.4	0.2	12	0.3	1320	0.03	0.03	21
Carambola	22	0.2	0.4	3	0.7	650	0.03	0.02	39
Beverages									
Jasmine tea, leaves	263	24.1	3.5	320	31.6	14000	0.07	0.79	85

Reference: *http://* www.doh.gov.tw/org2/b3/database/

Tung et al. 1961. Composition of foods used in Taiwan. *J Formosan Med Assoc.* 60: 973-1005.

The Chinese foods, which were chosen for this study, were similar to those used in the study by the Lee et al. 1992(I) and 1992(II). These researchers focused on foods predictive of the intake of total calories, protein, fat, vitamin A, riboflavin, thiamin, vitamin C, and calcium. White

rice is the number one predictor food for caloric intake from a dietary intake in Taiwan, 1980-1981. Rice is the most important staple food in Taiwan. Other foods like steamed foods and Chinese pork sausages are also among the top ten major predictor foods for caloric intake. Chicken leads the list of the major predictor foods for protein intake. Polished rice is the second major protein intake from the list. Medium-fat pork and lean pork are the third- and fourth-ranked foods. Pork, dried and crushed is included in the list of major predictor foods for protein intake. Pork, medium-fat leads the list of the predictor foods for fat intake, pig feet, pork sausage, gluten fried, pig intestine, lychees and soybean curd are all among the top 20 major predictor foods for fat intake from a dietary survey in Taiwan (Lee et al. 1992).

Chicken liver is the top vitamin A predictor, although its contribution to the average vitamin A intake was only 8.8%. Several vitamin A- or vitamin C- rich fruits (mangoes, papaya), dark green vegetables (sweet potato leaves, Chin-Chian Bo-Tsai, mustard greens), green tea leaves and other types of liver also appeared in the top 20. Enriched rice (brown rice) was the best predictor food for vitamin B1, explaining 67% of the vitamin B1 variation, although its absolute contribution to vitamin B1 intake is small (3.2%). Medium-fat pork (13.1%), lean pork (12.6%), polished rice (23%) and pork sausage (2.3%) ranked the second to the fifth in contribution to vitamin B1 intake. Approximately 92% of the B1 variation can be accounted for by these five foods that correspond to only 54.2% of mean vitamin B1 intake. Enriched rice again topped the vitamin B2 predictor list. Chicken liver, pork liver, dried Chinese mushrooms were the second to fourth contributors. Fruits ranked at the top in predicting vitamin C intake. The first five foods were guavas, oranges, papayas, lychees, and mangoes. Dried small fish and soybean curd are among the top ten foods in predicting calcium intake (Lee et al. 1992).

7. Food Frequency Questionnaire

Food Frequency Questionnaires (FFQs) have become widely used, particularly in epidemiologic research of chronic diseases, to characterize the dietary intakes of individual study participants. Such questionnaires are appealing because they are designed to measure usual or long-term intake, which is a more relevant determinant of chronic disease than are actual measures of recent diet (Feskanich et al. 1993). There are numerous FFQs essentially consisting of two parts: a list of foods or food groups and a set of response options indicating how often foods or food groups are consumed during a specific time period. The list of foods may vary considerably, from a brief list focusing on a specific nutrient to a list of several hundred foods designed to assess the total diet. The frequency of response options may be general (e.g., "often," "sometimes," "never") or more elaborate and specific (e.g., number of servings per day, per week, per month). Finally, the period of recall may vary, normally from one month to one year, and may be the period preceding the completion of the questionnaire or at some distant time (Wright and Guthrie 1995).

Various food questionnaires are termed semiquantitative in that they ask respondents questions about portion size. Some questionnaires ask respondents to describe a " typical" portion size, the amount of a "medium" serving, or indicate whether their intake of a food are "small", "medium", or "large", and others use pictures to illustrate different portion sizes (Wright and Guthrie 1995).

FFQs are considered cost-effective tools for dietary data collection. They can be self-administered; interviewer administered to individuals or by telephone, or administered using computerized precoded questionnaires. There are concerns about the cognitive demands of FFQs, which require both memory and use of mathematical computations. FFQs make demands on long-term memory. Questionnaires that ask about portion sizes require more judgments on the part of

respondents. FFQs are useful in describing intake of foods that may be consumed periodically but less able than food recalls or records to elicit information about intake of specific foods and amounts (Wright and Guthrie 1995). Some under and over reporting may occur. Studies of women indicated that the foods most often over reported were fruits and vegetables; meat and dairy products were most often underreported (Feskanich et al. 1993).

A semiquantitative dietary history questionnaire detected associations between diet and colorectal cancer among Chinese in China and in North America. In a subsequent study, a modified version of this semiquantitative dietary history questionnaire was used with the Chinese people in Taiwan and was concurrently validated for the study of the Chinese population. The instrument, to be used in a face-to-face interview lasting not more than 30 minutes on average, consists of a list of 84 food items. Portion size was asked only for food items frequently consumed (more than once a week). To help respondents describe more precisely their usual portion size, specially designed three-dimensional, actual-size food models representing the mixed dishes and single food items were used during the interview. Major sources of error associated with the semiquantitative dietary history questionnaire include recall, perceptions of usual portion size, and possibly the restrictions imposed by a fixed list of food items. Multiple diet records over time are often used for validating a food frequency questionnaire, because they are the least likely to involve dependent errors. Therefore, the selection or design of a dietary standard reference remains a challenge (Lee et al. 1994).

8. 24-Hour Recall

The twenty four-hour food recall obtains a more qualitative dietary assessment. When subjects are instructed to provide good information, self-administrated recalls may be acceptable. The 24-hour recall has become a favored way of obtaining dietary data. It requires only about 15

to 20 minutes of interview time. It is often taken at an unannounced time or with no prior indication of the nature of the data to be requested. Time and place of food consumption may be important factors to consider when developing nutrition care plans and designing therapeutic and educational interventions. Questions about vitamin and mineral supplement use are sometimes included in surveys but are seldom included in the computed data on vitamin and mineral intake. It is often difficult to quantify supplement intake data because clients may not remember what they use may use supplements irregularly, or because the actual nutrient content of supplements may be uncertain. However, information about supplement use may be helpful in reviewing dietary adequacy (Wright and Guthrie 1995).

Sometimes questionnaires are used to ask about the type of fat used in cooking meat, fish, and vegetables, and the consumption of visible fat on meat and skin on chicken. Although seasonal fruits and vegetables are not separated into "fresh in season", "canned", or "frozen" categories, participants may be instructed to state the frequency of consuming fruits and vegetables in season and not in season (Lee et al. 1994).

The 24-hour recall method is subject to criticism about accuracy. Some people may lack the cognitive ability to recall foods eaten, some may have little awareness of what they eat, and others may recall a "good" diet rather than what was actually eaten. Foods that are viewed as unacceptable (e.g., alcohol, fats) may be selectively forgotten. It is important that a nutritionist be well trained in conducting interviews and avoiding leading questions and verbal and nonverbal cues that appear to be judgmental about the recalled diets. Various aids are used to help with portion size estimation. These include measuring utensils, food models and pictures of foods or utensils. Multiple days of recall can improve estimates of an individual's usual intake (Wright and Guthrie 1995).

9. Implications for Future Research

A few studies have reported on changes in dietary patterns among different immigrant groups (Pan et al. 1999). However, limited data on dietary intake of Asian students living in the U.S are available. An understanding of food intake of Asian students is important in the development of nutrition education programs for these immigrants.

CHAPTER THREE

RESEARCH DESIGN AND METHODOLOGY

1. Human Subjects Consent Form

Methods and data collection instruments and consent forms used in this research study were approved by the all University Institutional Review Board Subcommittee. The consent form shown in Appendix B informs the subject that their participation is voluntary, that the data collected will be held in the strictest confidence, and that the subject may withdraw at any time.

2. Description of the Sample

The subjects recruited for this study were Taiwanese students enrolled at the University of Wisconsin-Stout. The list of the Taiwanese students was obtained from the Taiwanese Student Association. Potential subjects from this list were contacted by phone to ascertain their willingness to participate in the study. A total of twenty-three Taiwanese students expressed interest. The cover letters, which explained the interview process, were then mailed to the potential subjects (Appendix C). A face to face interview was then conducted to complete the data collection instruments.

3. Development of the Questionnaire

One 24-Hour Recall Form, Supplementary Questions, which obtained information about supplement use and fat consumed, and two Food Frequency Questionnaires were used in this study.

a) 24-hour Recall Form:

The purpose of the 24-hour Recall Form (Appendix D) in this study was to evaluate the accuracy of the United States food frequency questionnaire. The 24-hour recall form included

basic questions about food intake for the past 24 hours. The recall was obtained by face-to-face interview. The subjects were asked to recall all food eaten the day before and to estimate quantities in ordinary household measures or by shape or by dimensions. The 24-Hour Recall Form which was developed and used was very similar to the "Dietary Intake Recall Form: Beltsville Human Nutrition Research Center, USDA" (Frances and Thompson 1994).

b) The Method to Collect Data from the 24-Hour Recall Form:

Several strategies that are recommended for helping a client recall food intake were utilized in this study. First, it is important that the interviewer be well trained in conducting interviews and in avoiding leading questions as well as verbal and nonverbal cues that appear to be judgmental about the recalled diets. The interviewer obtained training by utilizing a videorecording, which the Oklahoma Cooperative Extension Service (Joyce and Williams 1998) has made available. The video described appropriate interviewing skills for the diet interview. A multiple-pass method was recommended to increase retrieval of memory. The client is first asked to recall all foods eaten in the previous 24 hours but not necessarily to describe them or to give amounts. The client may use memory guides such as time and place of eating. In the next pass, the interviewer begins to ask more probing questions about the type of food and amount. In a final pass, the interviewer will say, "Now I will read to you what I have written (recorded) about the foods you ate and the amounts. Let me know if I have done so correctly."

Various aids can also be used to help with the portion size estimation. These aids include measuring utensils, food models and pictures of foods or utensils (Wright and Guthrie 1995). The interviewer/researcher choose measuring utensils and pictures of food published by the American Dietetic Association for the visual aid of the American foods (Hess 1997). The portion size of

Taiwanese food came from "Diet by Calorie Method" (Chan et al. 1998), "Portion Photo of Food Exchange Handbook" (Chan et al. 1994), and "Food & Cooking Data" (Hayawakari 1997).

c) 24-hour Recall Supplementary Questions:

Several questions were included in the "24-Hour Recall Supplementary Questions" (Appendix E) in order to obtain additional information to supplement the actual food recall. One-third to one-half of Americans consume vitamin and/or mineral supplements regularly. About 70 percent have taken multivitamin and mineral supplements. It is often difficult to quantify supplement intake data because clients may not remember what they use, they may use supplements irregularly, and the actual nutrient content of supplements may be uncertain. However, information about supplement use may be helpful in reviewing dietary adequacy (Wright and Guthrie 1995). In this study, supplement data was collected to investigate if the Taiwanese students take vitamin supplements in the United States.

The 24-Hour Recall Supplementary Questions Form in this study was patterned after two studies. One resource used was Nutrition Assessment (Wright and Guthrie 1995). The rest of the questions were selected from "A semiquantitative dietary history questionnaire for Chinese Americans" (Lee 1994).

Questions were utilized to discern the type of fat used in cooking meat, fish, and vegetables, and whether the participant consumed visible fat on meat or the skin on chicken. These data can help reconfirm the accuracy of the client reports of their dietary habits (Lee et al. 1994).

d) Food Frequency Questionnaire

The same Food Frequency Questionnaire but with different titles and instructions was administered at two different times. One asked about the food intake in the participants' home country before attending the University of

Wisconsin-Stout (Appendix F). The other asked about the food intake after coming to the University of Wisconsin-Stout (Appendix G). The food frequency list was developed to determine the average number of times each day, week or month specific food items were consumed. Food items chosen for inclusion in the food list represented foods investigated in other research articles (Feskanich et al. 1993; Lee et al. 1994; Lee et al. 1992(I); Lee et al. 1992(II); Hrboticky and Krondl 1985). Food items chosen for the Food Frequency Questionnaire were based on the most popular American food and Chinese food available in the oriental store near the university or in the supermarkets within the study area. Other food items that reflect the average intake in Taiwan were chosen from two research articles (Lee et al (I); Lee et al (II), 1992) that indicated the most popular food in each of the different nutrient food groups. For example, chicken or pork liver were selected because they are the vitamin A rich foods commonly eaten in Taiwan. Food items were categorized according to the food type such as sweets, beverages, dairy, or meats (Tung et al. 1961). Nutrient values of Chinese foods were obtained from Taiwanese or Japanese reference books "Department of Health. The Executive Yuan" (From http://www.doh.gov.tw/org2/b3/database), "Composition of foods used in Taiwan" (Tung et al. 1961), "Food and Cooking Data" (Hayawakari 1997). These nutrient values were then input into the Food Processor Plus software program for subsequent analysis.

4. Data Analysis

a) Food Intake Analysis

The food processor plus nutrition analysis program, version 5.0; based on the latest USDA data plus over 800 additional scientific sources, was used to analyze the daily intake of total energy, carbohydrate, protein, total fat, cholesterol, total vitamin A, thiamin, riboflavin, vitamin B6, vitamin B12, vitamin C, vitamin E-tocopherol equivalents, calcium, and iron from both the 24-hour recall and the two food frequencies.

The foods on the food frequency questionnaire represented a core of nutrients to compare. Participants were asked the frequency of intakes and serving size for each of the foods listed. The frequency referred to daily, weekly, monthly, or never. If a food item intake frequency was seven times per week, it would be considered as the same intake frequency as once per day. If a food intake frequency was once monthly, the daily intake frequency would be 1/30. The food intake frequency data then was converted to estimate the specific daily nutrient intakes (Yang 1994).

b) Statistical Analysis

The Statistical Package for the Social Sciences (SPSS for Windows, release 4.1, 1993, SPSS, Chicago III) was used for data analysis. Mean values were compared using paired-samples t tests. A *P* value of .05 or less was considered statistically significant. Results were reported as mean $\pm$ standard deviation.

CHAPTER FOUR

RESULTS OF THE STUDY

1. Background Information

The purpose of this study was to identify the changes in the food intake of Taiwanese students at the University of Wisconsin-Stout compared to their food intake before they came to the United States. A total of twenty-three Taiwanese students indicated their interest in the study and served as the primary sample. Subjects were asked to complete one 24-hour recall and two food frequency questionnaires. Nutrients, which were investigated, included calories, protein, fat, vitamin A, thiamin, riboflavin, vitamin C, calcium and iron. The 24-hour recall determined the food intake of the subjects for the 24-hours previous to their interview. Two food frequency questionnaires were used. One food questionnaire determined the frequency of the subjects' food consumption the year before they came to the United States. The second food frequency determined the frequency of food consumption after the subjects came to the University of Wisconsin-Stout, Menomonie WI.

2. Characteristics of Subjects

There were 15 people (65% of the primary sample) who participated in this study. Table 2 presents the characteristics of the sample. The average age was 25.2 years old (SD $\pm$ 2.18) and the subjects' ages ranged from 22 to 29 years old. The average weight was 114.3 lb. (SD $\pm$ 18.30)

and the weight of the subjects ranged from 95 lb. to 165 lb. The average height of the participants was 63.3 inches (SD $\pm$ 0.25) and the height ranged from 61 inches to 69 inches. The activity level of most of the subjects was sedentary (47%); five of the participants were lightly active (33%), and three were moderately active (20%). The average body mass index was 20 (SD $\pm$ 1.82) and ranged from 16.8 to 24.4. Of the 15 participants, 13 were female (87%) and two were male (13%) (see figure 1).

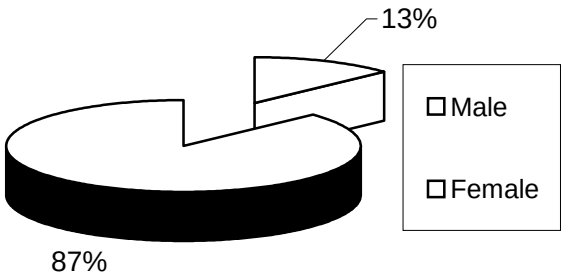

Figure 1. A graphic display of the gender of the Taiwanese participants

Table 2. Characteristics of Subjects

Characteristics	*N*	*%*	*Mean*	*Std. Dev.*
Total	15	100.0		
Gender				
Male	2	13.3		
Female	13	86.7		
Age (yrs old)			25.20	2.18
<25	9	60.0		
>25	6	40.0		
Weight (lb.)			114.3	18.30
<100	3	20.0		
100~110	6	40.0		
111~120	3	20.0		
>120	3	20.0		
Height (In.)			63.3	.25
61	3	20.0		
62	3	20.0		
63	6	40.0		
64	1	6.7		
69	2	13.3		
Activity				
Sedentary	7	46.7		
Lightly active	5	33.3		
Moderately active	3	20.0		
Body mass index			20.0	1.82
17.1~19.0	5	33.3		
19.1~21.0	6	40.0		
21.1~23.0	3	20.0		
>23.1	1	6.7		

3. Comparison of Calories, Macronutrients and Cholesterol

The comparison of calories, macronutrients and cholesterol between the 24-hour recall in the United States and the food frequency in the United States is shown in Table 3. There were no significant differences in the calories, macronutrients (protein, carbohydrate, and fat) and cholesterol between 24-hour recall in the United States and the calculated values from the food frequency in the United States. In addition, the comparison of these macronutrients expressed as a percentage of the RDA or of the recommended, as is case for carbohydrate, fat and cholesterol, showed no significant differences between the 24-hour recall and the food frequency questionnaire of food consumed in the United States.

Table 4 depicts the comparison of calories, macronutrients and cholesterol calculated from the food frequency questionnaire of foods consumed in the United States to the values calculated from the food frequency questionnaire of food consumed in Taiwan. The protein calculated from the Taiwan food frequency questionnaire was significantly higher (P=0.002) compared to the protein calculated from the United States food frequency questionnaire, 94g and 61g, respectively. Similarly, the percentage of protein compared to the RDA was also significantly higher (P=0.003) for the Taiwan food frequency questionnaire compared to the United States food frequency questionnaire, 231% and 148%, respectively. Cholesterol calculated from the Taiwan food frequency questionnaire

was not significantly different from the United States food frequency questionnaire, 384 mg and 301 mg, respectively, but did show a strong

Table 3. Comparison of ***Calories, Macronutrients and Cholesterol*** Intake Calculated from the 24-Hour Recall in the United States and the Food Frequency Questionnaire of Food Consumed in the United States.

Nutrient	24 Hour recall		United States		T value	Sig.
	Mean	SD	Mean	SD		
Calories (Kcal/day)	1716	618	1638	474	.352	.730
% calories compare with RDA	96	43	87	24	.707	.491
Protein(g/day)	74	25	61	19	1.606	.131
% protein compare with RDA	183	65	148	45	1.733	.105
Carbohydrate (g/day)	238	110	222	68	.455	.656
% carbohydrate compare with *recommended*	92	52	81	21	.844	.413
Fat (g/day)	52	22	56	23	-.377	.712
% fat compare with *recommended*	87	42	89	37	-.121	.905
Cholesterol (mg/day)	301	168	301	139	.014	.989
% cholesterol compare with *recommended*	101	56	100	46	.018	.986

Table 4. Comparison of ***Calories, Macronutrients and Cholesterol*** Calculated from the Food Frequency Questionnaire of Foods Consumed in the United States Compared to Values Obtained from the Food Frequency Questionnaire of Food Consumed in Taiwan.

Nutrient	United States		Taiwan		T value	Sig.
	Mean	SD	Mean	SD		
Calories (Kcal/day)	1638	474	1907	661	-1.416	.179
% calories compare with RDA	87	24	102	30	-1.662	.119
Protein(g/day)	61	19	94	36	-3.857	.002∗
% protein compare with RDA	148	45	231	101	-3.524	.003∗
Carbohydrate (g/day)	222	68	243	86	-.683	.505
% carbohydrate compare with *recommended*	81	21	89	25	-.856	.406
Fat (g/day)	56	23	63	27	-1.131	.277
% fat compare with *recommended*	89	37	100	39	-1.158	.266
Cholesterol (mg/day)	301	139	384	149	-1.970	.069
% cholesterol compare with *recommended*	100	46	128	50	-1.973	.069

∗ Values are considered significantly different at $P < 0.05$

tendency (P=0.069) to have significant difference. Compared to the recommended, the percentage of cholesterol from the Taiwan food frequency questionnaire also showed a strong tendency (P=0.069) to be greater than the percentage calculated from the United States food frequency questionnaire, 128% and 100%, respectively. The calculated intake and percent of the recommended of calories, carbohydrate and fat as reflected in the Taiwan food frequency questionnaire was not significantly different from that calculated from the United States food frequency questionnaire.

A comparison of calories, macronutrients and cholesterol intake calculated from the 24-hour recall in the United States and the food frequency questionnaire of foods consumed in Taiwan is presented in Table 5. Similar to the comparison of the 24-hour recall to the Taiwan food frequency questionnaire, there were no significant differences in the percentage of recommended or calculated values for calories, carbohydrate, fat, and cholesterol. The grams of protein (94 g) calculated from the Taiwan food frequency questionnaire showed a weak tendency (P=0.132) to be higher than the 24-hour recall (74 g). This trend was also evident when protein was expressed as a percentage of the RDA, 231% and 183%, respectively, for the Taiwan food frequency questionnaire and the 24-hour recall.

Table 5. Comparison of ***Calories, Macronutrients and Cholesterol*** Intake Calculated from the 24-Hour Recall in the United States and the Food Frequency Questionnaire of Food Consumed in Taiwan.

Nutrient	24 Hour recall		Taiwan		T value	Sig.
	Mean	SD	Mean	SD		
Calories (Kcal/day)	1716	618	1907	661	-.698	.497
% calories compare with RDA	96	43	102	30	-.438	.668
Protein(g/day)	74	25	94	36	-1.600	.132
% protein compare with RDA	183	65	231	101	-1.566	.140
Carbohydrate (g/day)	238	110	243	86	-.118	.908
% carbohydrate compare with recommended	92	52	89	25	.217	.832
Fat (g/day)	52	22	63	27	-1.013	.328
% fat compare with recommended	87	42	100	39	-.836	.417
Cholesterol (mg/day)	301	168	384	149	-1.235	.237
% cholesterol compare with recommended	101	56	128	50	-1.233	.238

4. Comparison of Vitamin A, Thiamin (B1), Riboflavin (B2), Vitamin B6 and Vitamin B12

Table 6 compares vitamin A and the vitamin B complex (thiamin, riboflavin, vitamin B6, and vitamin B12) calculated from the 24-hour recall in the United States to the food frequency questionnaire in the United States. Vitamin A was the only vitamin which was significantly different (P=0.015) in this comparison, 594 RE and 981 RE, respectively. Similarly, the percent RDA of the 24-hour recall was significantly lower (P=0.017) for the United States food frequency questionnaire, 74% and 119%, respectively.

The comparisons of vitamin A and the B complex vitamins from the food frequency questionnaire of food consumed in the United States to the food frequency questionnaire of foods consumed in Taiwan are presented in Table 7. Thiamin intake (1.72 mg) from the Taiwan food frequency questionnaire was significantly higher (P=0.006) than the thiamin intake (1.20 mg) calculated from the United States food frequency questionnaire. Similarly, vitamin B6 (1.83 mg) calculated from the Taiwan food frequency questionnaire was significantly higher (P=0.017) than the vitamin B6 (1.3 mg) calculated from the United States food frequency questionnaire. And the vitamin B12 (6.74 mcg) calculated from the Taiwan food frequency questionnaire was also significantly higher (P=0.001) compared to the vitamin B12 (3.34 mcg) calculated from the United States food frequency questionnaire. The percentage of the RDA for thiamin, vitamin B6, and vitamin B12 on the United States food frequency questionnaire (118%,

Table 6. Comparison of ***Vitamin A, Thiamin (B1), Riboflavin (B2), Vitamin B6 and Vitamin B12*** Intake Calculated from the 24-Hour Recall in the United States and the Food Frequency Questionnaire of Food Consumed in the United States.

Nutrient	24 Hour recall		United States		T value	Sig.
	Mean	SD	Mean	SD		
Vitamin A (RE/day)	594	500	981	735	-2.780	.015*
% Vitamin A compare with RDA	74	63	119	92	-2.709	.017*
Thiamin (B1) (mg/day)	1.27	.59	1.20	.42	.505	.621
% Thiamin-B1 compare with RDA	129	66	118	42	.764	.458
Riboflavin (B2) (mg/day)	1.33	.38	1.37	.45	-.264	.795
% riboflavin-B2 compare with RDA	112	38	113	38	-.059	.954
Vitamin B6 (mg/day)	1.54	.86	1.30	.48	1.091	.294
Vitamin B6 compare with RDA	95	55	79	31	1.124	.280
Vitamin B12 (mcg/day)	2.92	1.87	3.33	1.41	-.868	.400
Vitamin B12 compare with RDA	146	94	167	71	-.870	.399

* Values are considered significantly different at $P < 0.05$

Table 7. Comparison of ***Vitamin A, Thiamin (B1), Riboflavin (B2), Vitamin B6 and Vitamin B12*** Calculated from the Food Frequency Questionnaire of Foods Consumed in the United States Compared to Values Obtained from the Food Frequency Questionnaire of Food Consumed in Taiwan.

Nutrient	United States		Taiwan		T value	Sig.
	Mean	SD	Mean	SD		
Vitamin A (RE/day)	981	735	1050	606	-.362	.723
% Vitamin A compare with RDA	119	92	127	69	-.320	.754
Thiamin (B1) (mg/day)	1.20	.42	1.72	.69	-3.209	.006∗
% Thiamin B1 compare with RDA	118	42	169	57	-3.451	.004∗
Riboflavin (B2) (mg/day)	1.37	.45	1.51	.76	-.798	.438
% Riboflavin B2 compare with RDA	113	38	123	56	-.751	.465
Vitamin B6 (mg/day)	1.30	.48	1.83	.82	-2.721	.017∗
% Vitamin B6 compare with RDA	79	31	111	48	-2.794	.014∗
Vitamin B12 (mcg/day)	3.34	1.41	6.74	2.72	-5.190	.001∗
% Vitamin B12 compare with RDA	167	71	337	136	-5.199	.001∗

∗ Values are considered significantly different at $P < 0.05$

79%, and 167%, respectively) was also significantly lower than these values calculated from the Taiwan food frequency questionnaire (169%, 111%, and 337%, respectively). However, the calculated amounts and percentage of RDA for vitamin A and riboflavin were not significantly different in this comparison.

The comparison of vitamin A and the vitamin B complex calculated from the 24-hour recall in the United States and the Taiwan food frequency questionnaire is presented in Table 8. Vitamin A intake (594 RE) from the 24-hour recall was significantly lower (P=0.03) than the vitamin A intake (1050 RE) calculated from the Taiwan food frequency questionnaire. Thiamin intake (1.72 mg) calculated from the Taiwan food frequency questionnaire showed a very strong tendency (P=0.054) to be significantly higher than the thiamin intake (1.27 mg) calculated from the United States food frequency questionnaire. Vitamin B12 intake (6.74 mcg) calculated from the Taiwan food frequency questionnaire was significantly higher (P=0.001) than the 24-hour recall (2.92 mcg). The percentage of the RDA for vitamin A, thiamin, and vitamin B12 calculated from the Taiwan food frequency questionnaire (127%, 169%, and 337%, respectively) was significantly higher (P=0.028, 0.046, and 0.001, respectively) compared to the 24-hour recall (74%, 129%, and 146%, respectively). There was no significant difference in this comparison for the amount of riboflavin and vitamin B6 consumed or a significant difference in the percentage of the RDA for these two nutrients.

Table 8. Comparison of ***Vitamin A, Thiamin (B1), Riboflavin (B2), Vitamin B6 and Vitamin B12*** Intake Calculated from the 24-Hour Recall in the United States and the Food Frequency Questionnaire of Food Consumed in Taiwan.

Nutrient	24 Hour recall		Taiwan		T value	Sig.
	Mean	SD	Mean	SD		
Vitamin A (RE/day)	594	500	1050	606	-2.410	.030*
% Vitamin A compare with RDA	74	63	127	69	-2.444	.028*
Thiamin (B1) (mg/day)	1.27	.59	1.72	.67	-2.099	.054
% Thiamin compare with RDA	129	66	169	57	-2.186	.046*
Riboflavin (B2) (mg/day)	1.33	.38	1.51	.76	-.751	.465
% Riboflavin compare with RDA	112	38	123	56	-.605	.555
Vitamin B6(mg/day)	1.55	.86	1.83	.82	-.831	.420
Vitamin B6 compare with RDA	95	55	111	48	-.808	.433
Vitamin B12(mcg/day)	2.92	1.87	6.74	2.72	-4.703	.001*
Vitamin B12 compare with RDA	146	94	337	136	-4.705	.001*

* Values are considered significantly different at $P< 0.05$

5. Comparison of Vitamin C, Vitamin E, Calcium and Iron

The comparisons of vitamin C, vitamin E, calcium and iron calculated from the 24-hour recall in the United States and the food frequency questionnaire in the United States are shown in the Table 9. Iron intake (15 mg) calculated from the United States food frequency questionnaire was significantly higher (P=0.048) than the iron (12 mg) calculated from the 24-hour recall in the United States. Similarly, when iron was expressed as a percentage of the RDA, the United States food frequency questionnaire indicated a significantly higher percentage (P=0.04) than the 24-hour recall, 107% and 86%, respectively. Vitamin C, vitamin E and calcium showed no difference when the 24-hour recall in the United States was compared to the United States food frequency questionnaire either in intake or when expressed as a percentage of the RDA.

The Vitamin C, vitamin E, calcium and iron data calculated from the United States food frequency questionnaire is compared to the data calculated from the Taiwan food frequency questionnaire in Table 10. Vitamin E intake (6.91 mg) calculated from the Taiwan food frequency questionnaire was significantly higher (P=0.013) than the vitamin E (4.43 mg) calculated from the United States food frequency questionnaire. Similarly, the percentage of the RDA for vitamin E was also significantly higher (P=0.011) when the Taiwan food frequency questionnaire was compared to the United States food frequency questionnaire, 83% and 54%, respectively. In the comparison of the United States food frequency questionnaire to the Taiwan food frequency questionnaire, there were no significant differences in vitamin C or calcium. Iron

Table 9. Comparison of ***Vitamin C, Vitamin E, Calcium and Iron*** Intake Calculated from the 24-Hour Recall in the United States and the Food Frequency Questionnaire of Food Consumed in the United States.

Nutrient	24 Hour recall		United States		T value	Sig.
	Mean	SD	Mean	SD		
Vitamin C (mg/day)	94	103	135	99	-1.104	.288
%Vitamin C compare with RDA	156	172	224	166	-1.102	.289
Vitamin E (mg/day)	4.66	2.97	4.43	2.33	.234	.818
% Vitamin E compare with RDA	58	38	54	30	.292	.774
Calcium (mg/day)	495	250	484	188	.141	.890
% Calcium compare with RDA	55	29	55	25	.078	.939
Iron (mg/day)	12	4.80	15	5.29	-2.172	.048∗
% Iron compare with RDA	86	33	107	42	-2.266	.040∗

∗ Values are considered significantly different at $P < 0.05$

Table 10. Comparison of ***Vitamin C, Vitamin E, Calcium and Iron*** Calculated from the Food Frequency Questionnaire of Foods Consumed in the United States Compared to Values Obtained from the Food Frequency Questionnaire of Food Consumed in Taiwan.

Nutrient	United States		Taiwan		T value	Sig.
	Mean	SD	Mean	SD		
Vitamin C (mg/day)	135	99	164	104	-1.383	.188
%Vitamin C compare with RDA	224	166	274	173	-1.381	.189
Vitamin E (mg/day)	4.43	2.33	6.91	2.99	-2.826	.013∗
% Vitamin E compare with RDA	54	30	83	33	-2.906	.011∗
Calcium (mg/day)	484	188	580	354	-1.043	.315
% Calcium compare with RDA	55	25	67	48	-1.099	.290
Iron (mg/day)	15	5.29	18	7.00	-1.526	.146
% Iron compare with RDA	107	42	128	59	-1.356	.197

∗ Values are considered significantly different at $P < 0.05$

showed a weak tendency to be higher (P=0.146) as calculated from the Taiwan food frequency questionnaire than the amount calculated from the United States food frequency questionnaire, 18 mg and 15 mg, respectively.

Table 11 compares the intakes of vitamin C, vitamin E, calcium and iron of the 24-hour recall in the United States to the food frequency questionnaire in Taiwan. Iron intake (18 mg) calculated from the Taiwan food frequency questionnaire was significantly higher (P=0.028) than the iron (12 mg) calculated from the 24-hour recall. Calcium and vitamin C showed no significant difference in this comparison, although vitamin C intake tended to be higher (P=0.097) from the Taiwan food frequency questionnaire compared to the 24-hour recall (164 mg and 94 mg, respectively). Vitamin E intake also tended to be higher (P=0.098) as calculated by the Taiwan food frequency questionnaire compared to the 24- hour recall, 6.91 mg and 4.66 mg. Similarly, when expressed as a percentage of the RDA, both vitamin C and vitamin E determined from the Taiwan food frequency questionnaire also showed a tendency for significance when compared to the 24-hour recall (P=0.097 and P=0.10, respectively). The percentage of the RDA as calculated from the Taiwan food frequency questionnaire for vitamin C and vitamin E was 247% and 83%, respectively, whereas the percentage calculated from the 24-hour recall was 156% and 58%, respectively.

Table 11. Comparison of ***Vitamin C, Vitamin E, Calcium and Iron*** Intake Calculated from the 24-Hour Recall in the United States and the Food Frequency Questionnaire of Food Consumed in Taiwan.

Nutrient	24 Hour recall		Taiwan		T value	Sig.
	Mean	SD	Mean	SD		
Vitamin C (mg/day)	94	103	164	104	-1.782	.097
%Vitamin C compare with RDA	156	172	274	173	-1.779	.097
Vitamin E (mg/day)	4.66	2.97	6.91	2.99	-1.771	.098
% Vitamin E compare with RDA	58	38	83	33	-1.763	.100
Calcium (mg/day)	495	250	580	354	-.756	.462
% Calcium compare with RDA	55	29	67	48	-.873	.397
Iron (mg/day)	12	4.80	18	7.00	-2.809	.014*
% Iron compare with RDA	86	33	128	59	-2.442	.028*

* Values are considered significantly different at $P < 0.05$

CHAPTER FIVE

DISCUSSION

1. Nutrient Intake

A. Calories, Macronutrients and Cholesterol Intake of Taiwanese Students

The comparison of calories and protein expressed as percentage of the RDA as well as cholesterol, fat and carbohydrate expressed as percentage of the recommended is shown in Figure 2. The percentage of the RDA of protein calculated from the Taiwan food frequency questionnaire was significantly higher (P=0.003) compared to the protein calculated from the United States food frequency questionnaire. And the percentage of the RDA of protein calculated from the 24-hour recall shows no significant difference compared to that obtained from the United States food frequency questionnaire. The similarity of the 24-hour recall to the United States food frequency questionnaire demonstrates that the calculated protein from the United States food frequency questionnaire does reflect actual protein intake. However, the 24-hour recall compared to the Taiwan food frequency questionnaire did not show this significant difference, which may be due to the large standard deviation (183% $\pm$ 65% and 231% $\pm$ 101%, respectively). There were no significant differences in the percentage of RDA for calories or percentage of the recommended for carbohydrate, fat and cholesterol when comparisons were made among the 24-hour recall, the United States food frequency questionnaire and the Taiwan food frequency questionnaire.

The calculated values from the Taiwan food frequency questionnaire indicated

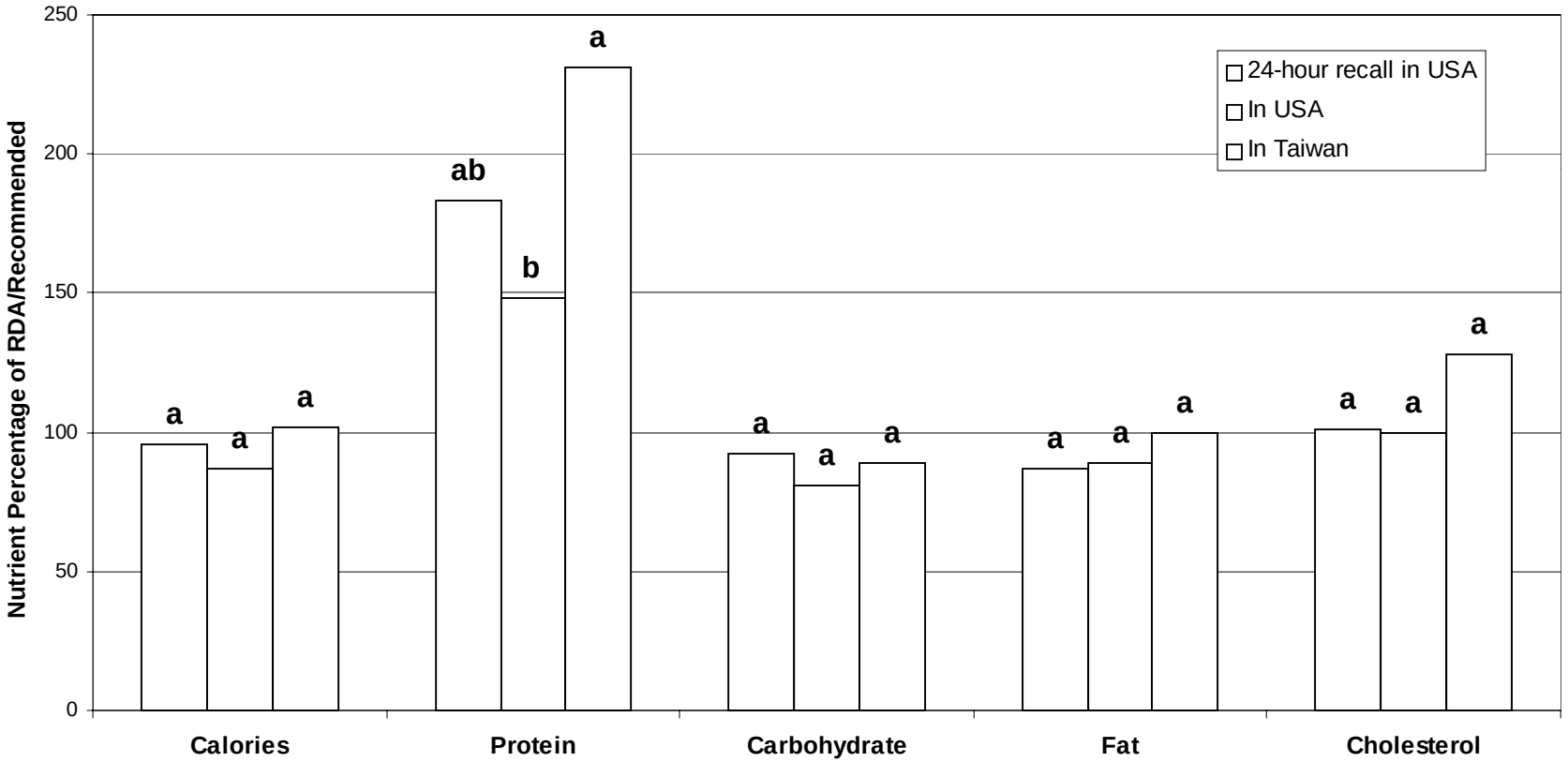

Figure 2. Comparison of calories, protein, carbohydrate, fat, and cholesterol intake calculated from the 24-hour recall in the United States, the United States food frequency questionnaire, and the Taiwan food frequency questionnaire.
Within a nutrient group, values with different letters are significantly different at $P < 0.05$; values for calories and protein represent the percentage mean of the RDA, whereas, values for carbohydrate, fat and cholesterol represent the percentage of recommended intake.

1907 calories, 243 g of carbohydrate, 94 g protein, 63 g of fat and 384 mg cholesterol. A study of Chinese working women by Shimbo et al. (1997) found participants consumed 1973 calories, 269 carbohydrate, 69 g protein, 73 g of fat and a range of intake of 179 to 248 mg of cholesterol. Fish and shellfish contributed 11% of the protein intake of these Chinese working women. Shellfish is a significant contributor of cholesterol to the diet and is reflected in the 384 mg cholesterol found in the Taiwan food frequency questionnaire in our study.

The present study found no significant difference in consumption of carbohydrate, fat, cholesterol and calories in contrast to the study by Pan et al. (1999). These authors found a significant increase in consumption of fats, sweets and dairy products in students attending a United States university who were born in China, Taiwan, Hong Kong, Japan or Korea. However, they found a significant decrease in meat, meat alternatives and vegetables when the students came to the United States. This finding mimics the lower protein intake found with the United States food frequency questionnaire in our study.

In the Chinese Total Diet Study by Chen and Gao (1993), the average protein intake was 64 g and the fat intake was 51.2 g or 21.2 % of the total energy consumed. In our study, the Taiwan food frequency questionnaire indicated 94 g of protein and 63 g of fat or 30% of total energy. This illustrates that these Taiwanese students consume more protein in Taiwan and once in the United States consume a diet that more closely parallels the Chinese diet as far as protein (61 g) is concerned. However, the intake of 56 g of fat remained the same. Caloric intake of the Taiwanese students was lower than the RDA, the fat expressed as a percentage of the total calories was 31%. This is a value very close to the recommended intake of fat, which is 30% of total calories.

Data extracted from the nutrition survey conducted by the Taiwan Department of Health is presented in Table 12. Calories, fat, carbohydrate, protein and cholesterol intake of males and females aged 20-24 and 25-34, is presented along with our data from the Taiwan food frequency questionnaire, United States food frequency questionnaire and the 24-hour recall. The intake of calories and carbohydrate reported by the Taiwan nutrition survey is very similar to our data collected by the United States food

frequency questionnaire, the 24-hour recall, and the Taiwan food frequency questionnaire. One notable difference is that the protein intake of the Taiwan food frequency questionnaire represents a greater percentage of total calories than that reflected in the United States food frequency questionnaire or the Taiwan nutrition survey. It should be mentioned that fat expressed as total percentage of calories ranged from 29% to 38% in the Taiwan nutrition survey, whereas, the Taiwan food frequency questionnaire, United States food frequency questionnaire and 24-hour recall ranged from 27% to 31% which is very close to the recommended. This may indicate that these Taiwanese students are at less risk of heart disease from excess fat consumption as a result of living in the United States. In contrast, cholesterol intake of females as reported by the Taiwan nutrition survey is considerably lower than that found with our instruments. However, the cholesterol intake from the United States food frequency questionnaire and the 24-hour recall did not exceed the recommended.

Table 12. A summary of the ***Calories, Protein, Carbohydrate, Fat and Cholesterol*** Intake from the Taiwan Nutrition Survey, 24-Hour Recall in the United States, Taiwan Food Frequency Questionnaire (FFQ) and the United States Food Frequency Questionnaire.

		age	No.	Calories		Protein			Carbohydrate		Fat		Cholesterol	
				Mean ± SD (Kcal/day)	%RDA[5]	Mean ± SD (g/day)	% RDA[5]	*%Cal.*	Mean ± SD (g/day)	*%Cal.*	Mean ± SD (g/day)	*%Cal.*	Mean ± SD (g/day)	*%Recom-mended*
1993-1996 Taiwan Nutrition Survey[1]	**Male**	20-24	149	2267 ± 1350	103%	89 ± 70	137%	16%	306 ± 173	55%	71 ± 63	29%	383 ± 271	96%
		25-34	400	2412 ± 1586	115%	88 ± 47	135%	15%	279 ± 128	48%	97 ± 138	37%	405 ± 318	101%
	Female	20-24	142	1495 ± 938	83%	52 ± 30	95%	14%	180 ± 106	48%	64 ± 64	38%	282 ± 320	71%
		25-34	383	1514 ± 658	89%	62 ± 34	112%	16%	190 ± 96	50%	58 ± 44	34%	308 ± 485	71%
Data from Taiwan FFQ[2]		25.20± 2.18	15	1907 ± 661	102%	94 ± 36	231%	19%	243 ± 86	51%	63 ± 27	30%	384 ± 149	128%
Data from United States FFQ[3]		25.20± 2.18	15	1638 ± 474	87%	61 ± 19	148%	15%	222 ± 68	54%	56 ± 23	31%	301 ± 139	100%
Data from 24-hour recall in the USA[4]		25.20± 2.18	15	1716 ± 168	96	74 ± 25	183	17%	238 ± 110	55%	52 ± 22	27%	301 ± 168	101%

1. The "1993-1996 Taiwan Nutrition Survey" was from the Department of Health. The Executive Yuan, Taiwan. The Republic of China. Http:// www.doh.gov.tw/org2/b3/nutrition/1-1-1.html
2. "Data from Taiwan FFQ (Food Frequency Questionnaire)" was extracted from our study (Table 4).
3. "Data from United States FFQ" was extracted from our study (Table 3).
4. "Data from 24-hour recall in the United States" was extracted from our study (Table 3).
5. The % RDA in 1993-1996 Taiwan Nutrition Survey was compare to the Recommended Daily Nutrient Allowances (RDA), 1993 (see Appendix A) in Taiwan.
   The % RDA in Data from Taiwan FFQ, Data from United States FFQ, and Data from 24-hour recall in the USA was compared to the Recommended Dietary Allowances (RDA), 1989 (see Appendix H) in the United States.

The study by Lee et al. (1992) investigated the foods predictive of nutrient intake in the Taiwanese diet. The author reported that chicken, polished rice, and pork are the major protein sources. Although Taiwanese students can buy pork and chicken in the United States grocery stores and can obtain rice in the oriental stores, the time required to study topics not in their native language may not allow them to cook by themselves, thus decreasing the intake of those foods. The students' life styles may promote consumption of American-style foods that are available and convenient.

B. Vitamin A, Thiamin (B1), Riboflavin (B2), Vitamin B6, and Vitamin B12 Intake of Taiwanese Students

Figure 3 indicates that thiamin (B1) expressed as a percentage of the RDA calculated from the Taiwan food frequency questionnaire (169%) was significantly higher (P=0.004) than that calculated from both the United States food frequency questionnaire (118%) and the 24-hour recall (129%) conducted in the United States. As the United States food frequency questionnaire closely mirrors the typical 24-hour food intake, this may be evidence that these two instruments provide similar results. The comparison of thiamin (B1) intake between the 24-hour recall in the United States and the Taiwan food frequency questionnaire showed strong tendency for significant difference (P=0.054) which provides additional evidence that the thiamin intake in Taiwan is greater than the thiamin intake in the United States. Vitamin B12 expressed as a percentage of the RDA showed similar results. The United States food frequency questionnaire and the 24-hour recall in the United States also indicated a much lower

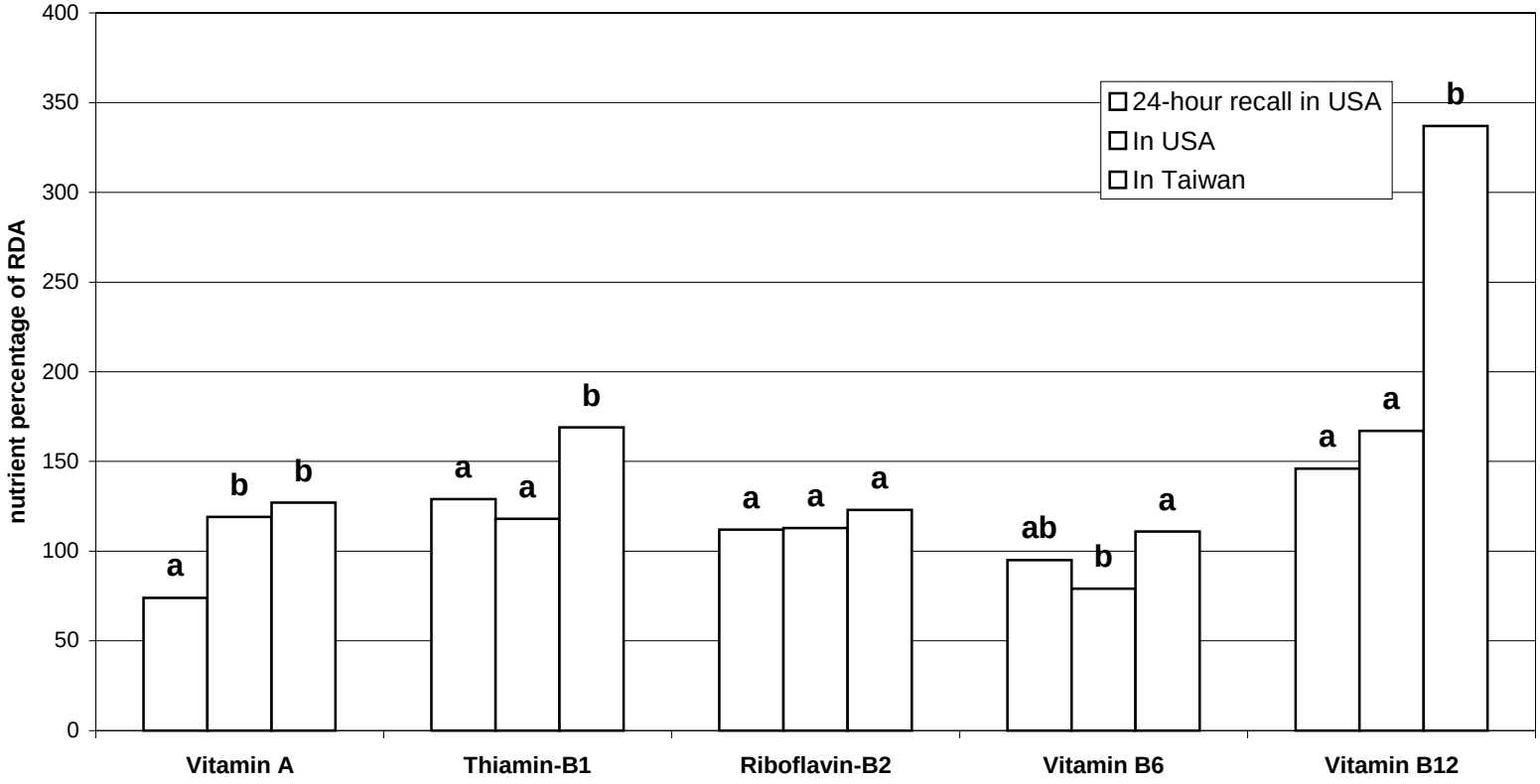

Figure 3. Comparison of vitamin A, thiamin (B1), riboflavin (B2), vitamin B6, and vitamin B12 intake of the 24-hour recall in the United States, the United States food frequency questionnaire, and the Taiwan food frequency questionnaire.

Within a nutrient group, values with different letters are significantly different at $P < 0.05$; values represent the mean percentage of the Recommended Dietary Allowances.

percentage of the RDA for vitamin B12 (167% and 146%, respectively) in the United States than that in Taiwan (337%).

The percentage of Vitamin B6 calculated from the Taiwan food frequency questionnaire (111%) was significantly higher (P=0.014) compared to the United States food frequency questionnaire (79%). However, the 24-hour recall was not significantly different from either the United States or Taiwan food frequency questionnaires. The vitamin B6 data closely parallels the protein data (figure 2), which also found a significant difference when the percentage of protein of the United States food frequency questionnaire was compared to the Taiwan food frequency questionnaire. However, there were no significant differences found between the 24-hour recall and the United States or the Taiwan food frequency questionnaire. This indicates vitamin B6 intake closely parallels protein consumption.

A study by Lee et al. (1992) reported that enriched rice was the best predictor food for vitamin B1 intake. However, its absolute contribution to vitamin B1 intake is small (3.2%). Medium-fat pork (13.1%), lean pork (12.6%) polished rice (23 %) and pork sausage (2.3%) ranked as the second to the fifth contributors to vitamin B1 intake. The top 20 list of major vitamin B1 predictor foods also included a variety of other foods such as protein-rich food (chicken, eggs, meat ball, pork liver), fruits (oranges, bananas), and vegetables (Chinese cabbage, carrots). Thus, pork is a significant contributor of vitamin B1 to the Taiwanese diet. Pork processing in the United States is different from the processing in Taiwan and results in a product that has a less preferred taste. The lower pork and protein intake on the United States food frequency questionnaire appeared to contribute to the lower vitamin B1 when the United States food frequency questionnaire and 24-hour recall was compared to the Taiwan food frequency questionnaire. The 24-hour data in the case of vitamin B1 is consistent with the United States food frequency questionnaire.

Few studies have been conducted since 1990 on the impact of migration on nutrient intake; more recent studies have concentrated on dietary food patterns rather than nutrient intake, especially vitamin A and the B complex vitamins. The study in China by Chen and Gao (1993) reported that the intakes of thiamin and riboflavin were below the RDA, retinol intake was also low in the Beijing area. Another study

by Tian et al. (1995) in the Tiamjin area of China also indicated low intakes of vitamin A as well as riboflavin. However, the most recent Nutrition Survey by the Department of Health in Taiwan (1993-1996) (see Table 13) showed the intakes of vitamin A, thiamin (B1), and riboflavin (B2) were above the RDA for Taiwanese, age 20 to 34. This may indicate that the study data of the Chinese population which come from the Mainland China area does not represent the nutrient intake of Chinese people from Taiwan.

Data extracted from the nutrition survey conducted by the Taiwan Department of Health on the Vitamin A and vitamin B complex intake of males and females aged 20-24 and 25-34 and from our United States food frequency questionnaire, Taiwan food frequency questionnaire and the 24-hour recall are presented in Table 13. The data on riboflavin from the Taiwan nutrition survey are very similar to our data from the Taiwan

Table 13. A Summary of the ***Vitamin A, Thiamin (B1), Riboflavin (B2)*** Intake from the Taiwan Nutrition Survey, 24-Hour Recall in the United States, Taiwan Food Frequency Questionnaire (FFQ), and the United States Food Frequency Questionnaire.

		Age	No.	Vitamin A		Thiamin (B1)		Riboflavin (B2)		Vitamin B6		Vitamin B12	
				Mean ± SD (RE/day)	%RDA[5]	Mean ± SD (RE/day)	% RDA[5]	Mean ± SD (mg/day)	% RDA[5]	Mean ± SD (mg/day)	% RDA[5]	Mean ± SD (mg/day)	% RDA[5]
1993-1996 Taiwan Nutrition Survey[1]	**Male**	20-24	149	1010 ± 1856	101%	1.47 ± 1.44	134%	1.33 ± 1.17	111%	No investigation		No investigation	
		25-34	400	1569 ± 2392	157%	1.39 ± 0.98	126%	1.41 ± 1.42	118%				
	Female	20-24	142	1194 ± 1741	142%	0.86 ± 0.66	96%	0.89 ± 0.68	89%				
		25-34	383	1365 ± 2172	162%	0.96 ± 0.75	107%	1.17 ± 1.21	130%				
Data from Taiwan FFQ[2]		25.20 ± 2.18	15	1050 ± 606	127%	1.72 ± 0.69	169%	1.51 ± 0.76	123%	1.83 ± 0.82	111%	6.74 ± 2.72	337%
Data from United States FFQ[3]		25.20 ± 2.18	15	981 ± 735	119%	1.20 ± 0.42	118%	1.37 ± 0.45	113%	1.30 ± 0.48	79%	3.34 ± 1.41	167%
Data from 24-hour recall in the USA[4]		25.20 ± 2.18	15	594 ± 500	74%	1.27 ± 0.59	129%	1.33 ± 0.38	112%	1.54 ± 0.86	95%	2.92 ± 1.87	146%

6. The "1993-1996 Taiwan Nutrition Survey" was from the Department of Health. The Executive Yuan, Taiwan. The Republic of China. Http:// www.doh.gov.tw/org2/b3/nutrition/1-1-1.html
7. "Data from Taiwan FFQ (Food Frequency Questionnaire)" was extracted from our study (Table 4).
8. "Data from United States FFQ" was extracted from our study (Table 3).
9. "Data from 24-hour recall in the United States" was extracted from our study (Table 3).
10. The % RDA in 1993-1996 Taiwan Nutrition Survey was compare to the Recommended Daily Nutrient Allowances (RDA), 1993 (see Appendix A) in Taiwan.
The % RDA in Data from Taiwan FFQ, Data from United States FFQ, and Data from 24-hour recall in the USA was compared to the Recommended Dietary Allowances (RDA), 1989 (see Appendix H) in the United States.

food frequency questionnaire, United States food frequency questionnaire and the 24-hour recall. In all cases, riboflavin exceeded the 100% of the RDA with the exception of Taiwanese females, 20 to 24 years of age, as reported by Taiwan nutrition survey. Thiamin intake from our Taiwan food frequency questionnaire was shown to be significantly higher (P=0.006) than that calculated from the United States food frequency questionnaire and showed a strong tendency (P=0.054) to be higher than the 24-hour recall. Thiamin intake calculated from our Taiwan food frequency questionnaire appears to be higher than that reported for females in the Taiwan nutrition survey of 1996. However, all data represented on Table 13 meets the RDA for thiamin with the exception of women 20 to 24 years of age as reported by the Taiwan nutrition survey. Vitamin A intake from the Taiwan nutrition survey, Taiwan food frequency questionnaire, and the United States food frequency questionnaire exceeds the RDA. However, the percentage of vitamin A intake as reflected by the 24-hour recall is significantly lower than the percentages of vitamin A calculated from the Taiwan food frequency questionnaire and the United States food frequency questionnaire. The finding that the 24-hour recall did not meet the RDA may reflect the dietary pattern of consuming a variety of fresh vitamin A-rich foods when they are in season or of acceptable quality.

C. Vitamin C, Vitamin E, Calcium and Iron Intake of Taiwanese Studies

According to the comparison in Tables 9 to 11 (see figure 4), vitamin E expressed as a percentage of the RDA was significantly lower ($P < 0.05$) as calculated from the United States food frequency questionnaire (54%) compared to the Taiwan food frequency questionnaire (83%). However, vitamin E intake as calculated from the 24-hour food recall (58%) was not significantly different from the United States or the Taiwan food frequency questionnaires. The percentage of the RDA calculated from the Taiwan and United States food frequency questionnaires for vitamin C, calcium and iron was not significantly different. However, the 24-hour food recall percentage of the RDA for iron (86%) was significantly different from the percentage of RDA of iron calculated from the Taiwan food frequency questionnaire (128%) and the United States food frequency questionnaire (107%) ($P=0.028$ and $P=0.040$, respectively). The percentages of RDA of calcium and vitamin C were not significantly different when comparisons were made of the 24-hour recall, Taiwan food frequency questionnaire, and the United States food frequency questionnaire.

Data of vitamin C, vitamin E, calcium and iron extracted from the nutrition survey conducted by the Taiwan Department Health is presented in Table 14. The vitamin C intake represented as a percentage of the RDA from the Taiwan nutrition survey, Taiwan food frequency questionnaire, and the United States food frequency questionnaire were very similar. However, the intake of vitamin C in each comparison

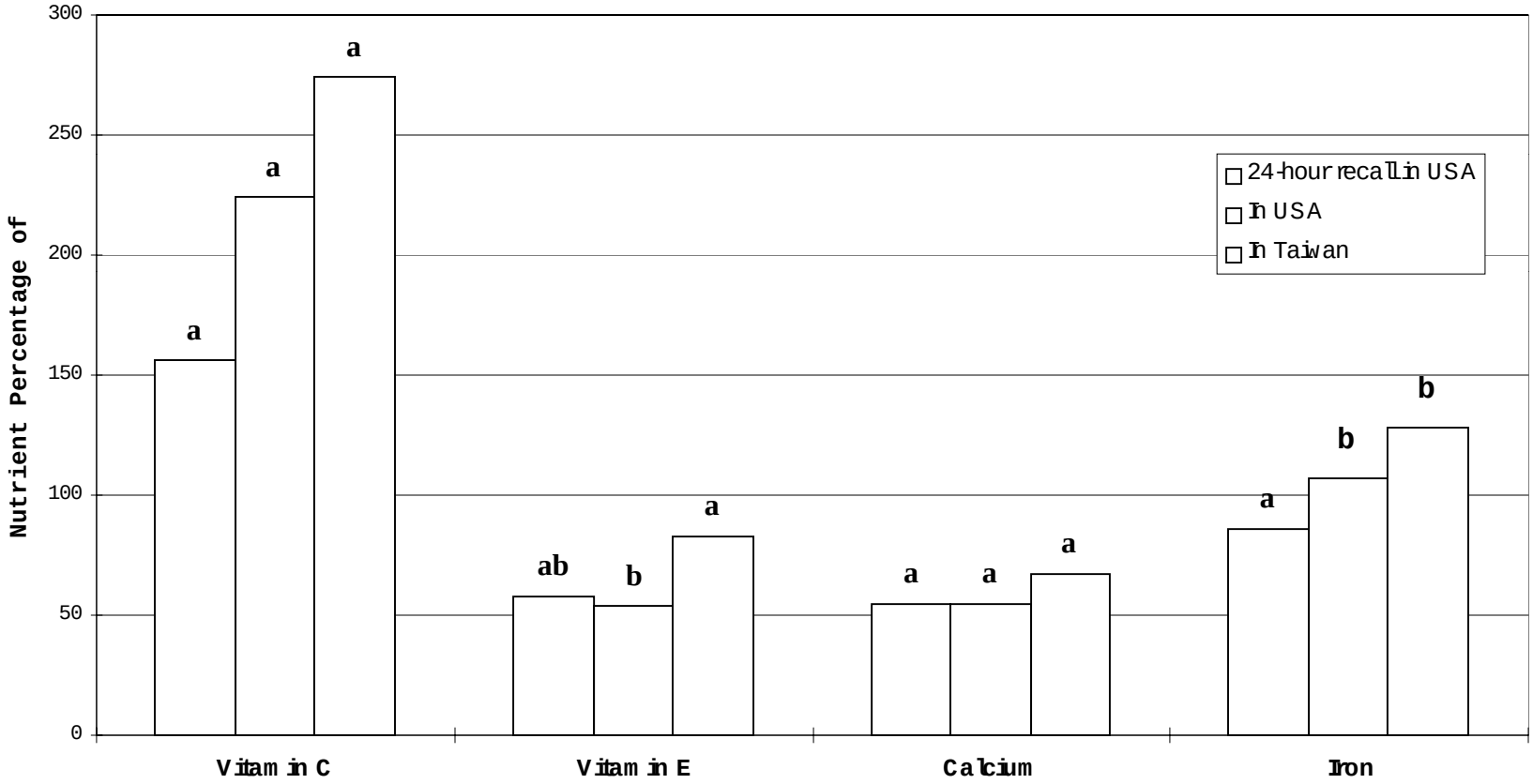

Figure 4. Comparison of vitamin C, vitamin E, calcium, and iron intake of the 24-hour recall in the United States, the United States food frequency questionnaire, and the Taiwan food frequency questionnaire.

Within a nutrient group, values with different letters are significantly different at $P < 0.05$; values represent mean percentage of Recommended Dietary Allowances.

Table 14. A Summary of the ***Vitamin C, Vitamin E, Calcium and Iron*** Intake from the Taiwan Nutrition Survey, 24-Hour Recall in the United States, Taiwan Food Frequency Questionnaire (FFQ), and the United States Food Frequency Questionnaire.

		Age	No.	Vitamin C		Vitamin E		Calcium		Iron	
				Mean ± SD (mg/day)	%RDA[5]	Mean ± SD (mg/day)	% RDA[5]	Mean ± SD (mg/day)	%RDA[5]	Mean ± SD (mg/day)	%RDA[5]
1993-1996 Taiwan Nutrition Survey[1]	**Male**	20-24	149	175 ± 244	292%	7.10 ± 7.27	59%	453 ± 382	57%	16.05 ± 18.25	107%
		25-34	400	163 ± 219	272%	7.92 ± 6.03	66%	513 ± 504	86%	15.44 ± 12.26	154%
	Female	20-24	142	144 ± 162	240%	6.43 ± 4.74	64%	349 ± 271	50%	9.7 ± 7.2	65%
		25-34	383	179 ± 295	298%	6.98 ± 5.86	70%	457 ± 454	76%	11.21 ± 6.8	75%
Data from Taiwan FFQ[2]		25.20 ± 2.18	15	164 ± 104	274%	6.91 ± 2.99	83%	580 ± 354	67%	18 ± 7.0	128%
Data from United States FFQ[3]		25.20 ± 2.18	15	135 ± 99	224%	4.43 ± 2.33	54%	484 ± 188	55%	15 ± 5.29	107%
Data from 24-hour recall in the USA[4]		25.20 ± 2.18	15	94 ± 103	156%	4.66 ± 2.97	58%	495 ± 250	55%	12 ± 4.80	86%

11. The "1993-1996 Taiwan Nutrition Survey" was from the Department of Health. The Executive Yuan, Taiwan. The Republic of China. Http:// www.doh.gov.tw/org2/b3/nutrition/1-1-1.html
12. "Data from Taiwan FFQ (Food Frequency Questionnaire)" was extracted from our study (Table 4).
13. "Data from United States FFQ" was extracted from our study (Table 3).
14. "Data from 24-hour recall in the United States" was extracted from our study (Table 3).
15. The % RDA in 1993-1996 Taiwan Nutrition Survey was compare to the Recommended Daily Nutrient Allowances (RDA), 1993 (see Appendix A) in Taiwan.
    The % RDA in Data from Taiwan FFQ, Data from United States FFQ, and Data from 24-hour recall in the USA was compared to the Recommended Dietary Allowances (RDA), 1989 (see Appendix H) in the United States.

with the exception of the 24-hour recall was more than twice the RDA. The percentage of the RDA of vitamin C calculated from the 24-hour recall (156%) showed a tendency (P=0.097) to be lower than the Taiwan food frequency questionnaire although at 156% was still well above the recommended. The intake of vitamin E calculated from the United States food frequency questionnaire is significantly lower than the vitamin E intake calculated from the Taiwan food frequency questionnaire. As presented in Table 14, the intake of both vitamin E and calcium were below the RDA for each data comparison presented, including the Taiwan nutrition survey, Taiwan food frequency questionnaire, United States food frequency questionnaire and the 24-hour recall intake in the United States.

Fruits ranked at the top in predicting vitamin C intake (Lee et al. 1992) in Taiwan. The first five foods were guavas, oranges, papayas, lychees and mangoes. The study by Pan et al. (1999) reported that the fruit intake was significantly increased after the Asian students moved to the United States. Our study showed no significant difference between the vitamin C intake calculated from the Taiwan food frequency questionnaire and the United States food frequency questionnaire. Fruit availability would differ to some extent in Taiwan and in the United States, depending on the climate, transportation, and economic situation. The study by Pan et al. (1999), which indicated an increased consumption of fruits by Asian students, was conducted in Florida where a variety of citrus fruits are grown and are readily available. In Wisconsin, citrus fruits are seasonally of better quality in certain months. Also, cold juice consumption is not tolerated as well in the colder climate. Seasonality of the fruit and the cold weather when the 24-hour recall was taken may have decreased the amount of fruit and thus lowered but not significantly so, the reported amounts of vitamin C consumed on the 24-hour recall.

The percentage of the RDA for vitamin E from the Taiwan nutrition survey (average 64%), Taiwan food frequency questionnaire (83%), United States food frequency questionnaire (54%) and 24-hour recall was extremely low (Table 14). The study conducted by Shimbo et al. (1997) in Taiwan also reported the insufficient intake of vitamin E compared to the recommended dietary allowances in Chinese working women. A study by Meydani (1999) found that various antioxidant supplements

including vitamin E started in early life might promote longevity. Vitamin E can modulate immune/endothelial cells interaction, thus reducing the risk of cardiovascular disease (CVD). Thus, antioxidants such as vitamin E from food sources or supplements appear to be promising for successful aging by improving immune function, and reducing the risk of several age-associated chronic diseases, such as CVD. Supplementation of the diets of the Asian students with vitamin E may be warranted.

Although the percentages of the RDA for Taiwan and United States food frequency questionnaires for calcium intake were not significantly different, the intake was very low. Calcium consumption of Asian individuals may be a risk factor for osteoporosis. The percentages of the RDA in the 1993-1996 Taiwan nutrition survey were as follows: male 20 to 24 years old, 57%; male 25 to 34 years old, 86%; female 20 to 24 yeas old, 50%; and female 25-34 years old, 76%. For each age group in the Taiwan nutrition survey, calcium intake was below the recommended. In our study, the calculated percentage of the RDA for calcium from the Taiwan food frequency questionnaire (67%), the percentage of the RDA for calcium calculated from the United States food frequency questionnaire (55%), and the percentage of RDA for calcium as reported in the 24-hour recall in the United States (55%), were well below the RDA.

Studies conducted in Hong Kong (Lau and Cooper 1993, Lau and Cooper 1996) indicated that the incidence rate of hip fracture in Asia has increased 3-fold since 1966. It has been projected that 50% of all hip fractures in the world will occur in Asia by the next century. The bone mineral density (BMD) of Asian populations is comparable to that of whites after adjusting for height and weight. Physical inactivity, a low dietary calcium intake, and falls have been found to be major risk factors for hip fractures in Asia. Another study on the determinants of bone mass in young Chinese women aged 21-40 in Hong Kong (Ho et al. 1994) also showed a very low calcium intake (448 mg/day, Standard deviation=219). A study conducted by the National Taiwan University Hospital in 1992 reported that the prevalence of vertebral fractures was 18% for women and 12% for men older than 65 year in the major cities of Taiwan (Tsai 1997). Hip and vertebral fractures are both associated with lower BMD

values. The risk factors for low BMD in Taiwan include a lighter body weight and aging in both sexes, and menopause for women. Tsai (1997) also found that in Taipei City, daily calcium intake is relatively lower (mean intake SD; 640 $\pm$ 240 mg). There was a significant association between a higher daily calcium intake and a higher BMD/lower bone turnover rate for women. Favorable calcium intake may be beneficial for Taiwanese, especially women, with habitual low dietary calcium intake.

The RDA for iron in Taiwan is lower than the United States RDA. Even through the RDA for iron is lower than the United States, the Taiwan nutrition survey indicated that iron intake expressed as a percentage of the RDA was low for Taiwanese females. However, Taiwanese males achieved the RDA. Our study showed no significant difference in the percentage of the RDA for iron between the United States and the Taiwan food frequency questionnaire and also showed that the Taiwanese female students achieved the RDA. However, the 24-hour recall in which the percentage of RDA is low as well as the low iron intake of Taiwanese females found by the Taiwan nutrition survey leaves some doubt as to the adequacy of iron intake for the Taiwanese female students.

A survey of iron status of school children and adolescents was carried out in Taiwan. Iron deficiency was defined as ferritin levels < 12 mg/L. For teenage subjects (aged 13 to 19.9 years), the rate of iron deficiency in males was 1.22% in Pingtung and 0% in Taichung, and that in females was 9.38% in Pingtung and 26.4% in Taichung. The anemia rate in males was 3.66% in Pingtung and 3.45% in Taichung, and that in females was 8.33% in Pingtung and 5.75% in Taichung. In both areas, iron deficiency was more prevalent in teenage females than in teenage males. Iron deficiency is not the major underlying cause of anemia, and iron deficiency anemia is relatively rare (<2%) in Taiwan. Teenage girls are identified as the group at risk of iron deficiency and anemia (Shaw 1996). Another survey from the Taiwan Department of Health identified that 93.3% of Taiwanese females over age 14 achieved the Taiwan iron RDA. The percentage of iron insufficiency of Taiwan females (> 14 yrs) was 11.7, and the iron sufficiency was 88.3% (from http://www.doh.gov.tw/org2/b3/nutrition/3-5.html).

Thus, it appears that iron deficiency is more characteristic of teenage girls rather than women aged 22 to 28 that made up our study sample.

Another recent study (Root et al. 1999) determined the iron status among premenopausal and recently postmenopausal Chinese women (aged 32 to 66 years old) in rural China. The authors reported that total iron intake was relatively high (15-29 mg/day) compared to developed countries. Overall levels of iron deficiency anemia were relatively low in these generally iron-stressed women. There was no clear statistical relationship between iron intake and physiological iron status. Dietary animal protein was significantly positively correlated ($r=0.15$, $P=0.009$) with plasma ferritin. Intakes of potential inhibitors of iron absorption, such as tea, even in very high amounts, were not correlated to iron status. Iron nutriture in these areas of rural China seemed more related to physiological, than to dietary factors. These studies do not reflect iron deficiency in Taiwan females, age 20 to 34. However, iron insufficiency may be present in pregnancy or menses or other kinds of physical stress.

2. Limitations of This Study

The limitations of this study include the omission of questions to analyze the effect of length of stay at the University of Wisconsin-Stout and in the United States upon weight change and food intake. Also, Taiwanese students frequently travel back to their country for two or three months in the summer or one month in the winter time, which may cause confusion in recalling food intake for the food frequency questionnaires. Furthermore, the use of the food frequency questionnaire may be a problem especially for students who have stayed in the United States for over one or two years without returning to Taiwan. They may have forgotten their dietary pattern in Taiwan.

Vitamin supplement usage was not easy to determine because most of the participants take supplements randomly or infrequently. Cooking oil usage greatly influences the fat intake. Most of the students did not prepare foods in Taiwan so they have limited knowledge of the amounts and kind of oils they used. In the United States, knowledge of restaurant preparation of food is also limited. This may affect the amount of reported fat as well as the vitamin E intake, which is abundant in plant oil.

3. Applications/Conclusions

The investigation of acculturation changes in food intake of Taiwanese students attending the University of Wisconsin-Stout observed that there were significant decreases in the intake of protein, thiamin, vitamin B6, vitamin B12 and vitamin E of students attending the University of Wisconsin-Stout in the United States. In the comparison of the United States food frequency questionnaire to the Taiwan food frequency questionnaire, calories, carbohydrate, fat, cholesterol, vitamin A, riboflavin, vitamin C, calcium, and iron intake did not have significant differences. Compared to the percentage of the United States recommended dietary allowances, both vitamin E and calcium are well below the RDA. As no large increases in fat, or cholesterol were found, the risk for heart disease from these factors was not increased. However, the decreased intake found in the United States for vitamin B6 known to cause increases in homocysteine, a risk factor for heart disease as well as the decrease in vitamin E, which is protective of lipid oxidation and subsequent artery damage is a cause for concern (Meydani 1999). Additionally, the low calcium intake found in our study (Ho et al. 1994, Lau and Cooper 1993, Lau and Cooper 1996, Tsai 1997) is associated with hypertension, a risk factor for heart disease and the high incidence of osteoporosis. Low intakes of these nutrients should become a starting point for dietitians in designing nutrition intervention for the Asian immigrants.

Our observations can help dietitians to understand the change in nutrient intake that occurs in young Asians attending the United States universities. The dietitian can use this information to plan strategies for their nutrition education to improve the calcium intake of Asian students who experience lactose-intolerance and have low calcium intakes. It is suggested that future studies concentrate on these nutrients (vitamin B6, vitamin E and calcium) and their relationship to chronic diseases. This information may help the dietitian provide nutrition counseling to their Asian clients.

APPENDIX-A

RECOMMENDED DAILY NUTRIENT ALLOWANCES IN TAIWAN

Recommended Daily Nutrient Allowances in Taiwan

Revised by 1993

		20~24 years old		25~29 years old	
		Male	**Female**	**Male**	**Female**
Height (cm)		170	158	170	158
Weight (Kg)		62	52	62	52
Calories (Kcal)		∗**S**: 2200 **L**: 2450 **M**: 2850 **H**: 3300	**S**: 1800 **L**: 2000 **M**: 2350 **H**: 2650	**S**: 2100 **L**: 2350 **M**: 2750 **H**: 3100	**S**: 1700 **L**: 1900 **M**: 2200 **H**: 2500
Protein (g)		65	55	65	55
Vitamin A	***(μg R.E.)***	600	500	600	500
	(I.U.)	5000	4200	5000	4200
Vitamin E (mg α-T.E.)		12	10	12	10
Vitamin C (mg)		60	60	60	60
Thiamin-B1 (mg)		**S**: 1.1 **L**: 1.2 **M**: 1.4 **H**: 1.7	**S**: 0.9 **L**: 1.0 **M**: 1.2 **H**: 1.3	**S**: 1.1 **L**: 1.2 **M**: 1.4 **H**: 1.6	**S**: 0.9 **L**: 1.0 **M**: 1.1 **H**: 1.3
Riboflavin-B2 (mg)		**S**: 1.2 **L**: 1.3 **M**: 1.6 **H**: 1.8	**S**: 1.0 **L**: 1.1 **M**: 1.3 **H**: 1.5	**S**: 1.2 **L**: 1.3 **M**: 1.5 **H**: 1.7	**S**: 0.9 **L**: 1.0 **M**: 1.2 **H**: 1.4
Vitamin B6 (mg)		1.6	1.4	1.6	1.4
Vitamin B12 (μg)		2.0	2.0	2.0	2.0
Calcium (mg)		800	700	600	600
Iron (mg)		10	15	10	15

∗ **S, L, M, H** means Activity levels:

S: Sedentary; **L**: lightly active; **M**: Moderate active; **H**: Heavy active

**** Source:*** *Department of Health, the Executive Yuan, Taiwan.* ***http:// www.doh.gov.tw/org2/b3/***

APPENDIX-B

HUMAN RESEARCH SUBJECTS CONSENT FORM

Human Research Subjects Consent Form

I understand that by returning this questionnaire, I am giving my informed consent as a participating volunteer in this study. I understand the nature of the study and agree that any potential risks are exceedingly small. I also understand the potential benefits that might be realized from the successful completion of this study. I am aware that the information is being sought in a specific manner so that no identifiers are needed and so that confidentiality is guaranteed. I realize that I have the right to refuse to participate and that my right to withdraw from participation at any time during the study will be respected with no coercion or prejudice.

NOTE: Questions or concerns about participation in the research or subsequent complains should be addressed first to the researcher or research advisor and second to Dr. Ted Knous, Chair, UW-Stout Institutional Review Board for the Protection of Human Subjects in Research, 11 HH, UW-Stout, Menomonie, WI, 54751, phone (715) 232-1126

APPENDIX-C

COVER LETTER

----------This is a Nutrition Survey----------

Date:

Name and address:

Dear _____:
What should you eat to maintain your health status? --- Nutrition and health is currently a hot topic.

We would like to find out the difference of dietary nutrient intake before and after Taiwanese students come to the United States. Your answers to this survey will be used to provide the dietetic professions more accurate information about the Taiwanese immigration for nutrition education.

The survey includes one 24 – Hour Recall Form, Supplementary Questions and two Food Frequency Questionnaires. You will be interviewed two times. In the first interview, you will complete the Food Frequency Questionnaire about the food intake since you came to the United States, and the 24 – Hour Recall form and Supplementary Questions. In the second interview, you will be asked to complete the Food Frequency Questionnaire about the food intake before you came to the United States.

Your answers are confidential. You need not put your name on the questionnaire. You may receive a summary of the results by writing " Result Requested" on the end of the questionnaire. We would be most happy to answer any questions you might have. You may email to me at the below address or call (715) 235-8027.

Thank you for your assistance.

Sincerely,

Yiping Lu
Department of Food Science and Nutrition
University of Wisconsin – Stout.
luy@post.uwstout.edu

APPENDIX-D

24-HOUR RECALL FORM

Name: ..... Date of recall: ..... ***Note***: use a separate line for each food item

Time						Place			Food and Beverages	For each food or beverages listed in the column. How much did you eat or drink?							Complete description	Did your food have salt added?			
										Number of units						Size of Description Of other		Yes(y) No(N)	during cooking	At the table	unknown
Am	Pm	hr		min		home	away	identify		oz	g	TB	Tsp	cup	other						

APPENDIX-E

24-HOUR RECALL SUPPLEMENTARY QUESTIONS

24-Hour Recall Supplementary Questions

1. How does the amount of food you consumed yesterday compare with the amount that you usually consume for that day of the week?
   ..... Much more than usual
   ..... Usual
   ..... Much less than usual
   ..... Don't know

2. Do you take nutrient supplements?
   ..... Yes. For how long have you taken them? Months: ..... Years: .....
   ..... No.

If yes, answer the questions below:

Type	***yes***	***no***	***How many? Per day/wk,etc***	***Brand***	***Strength (mg, I.U, etc)***
Multivitamins					
Multivitamins & Minerals					
Vitamins: Vitamin C					
Vitamin E					
Others:					
Minerals: Calcium					
Iron					
Others:					

3. Questions about fat consumed

	Never	***Seldom***	***Often***	***Always***	***Food not eaten***	***Do not recall***
When you ate meat, how often did you trim the fat off the meat?						
When you ate meat, how often was it cooked in oil, butter, lard, bacon fat, or margarine?						
When you ate chicken, how often did you eat it with the skin on it?						
When you ate chicken, how often was it cooked in oil, butter, lard, bacon fat, or margarine?						
When you ate fish, how often was it cooked in oil, butter, lard, bacon fat, or margarine? This includes adding oil to steamed fish.						
When you ate vegetables, how often did you add butter/margarine to them?						
When you ate vegetables, how often did you eat them stir fried?						

♠***Seldom***: < 1/2 the time; ***Often***: .1/2 the time

APPENDIX-F

TAIWAN FOOD FREQUENCY QUESTIONNAIRE

Food Frequency Questionnaire

Code#: ..... Date: .....

Please indicate how much and how often you have eaten the following foods ***before*** *attending* to the U.S. When answering think about your usual diet over the past months. Please considers the serving size and marks how many servings you eat under the column" how often".For example, if you have 2 cups (16 fluid oz) of milk at one meal and 1 time per day, mark "2" at the "Column 1" under"Times/day".

Food list	Serving Size	**How often?**													
		never	**Times/ month**			**Times/week**						**Times/day**			
		0	1	2	3	1	2	3	4	5	6	1	2	3	4+
Dairy product															
Cottage cheese, ricotta	1/2cup														
Cream cheese	1Tb														
Other cheese – Cheddar, Swiss	1slice														
Cream (whipping cream)	1T														
Ice cream, frozen yogurt	1cup														
Milk (skim/ 1%/ 2%/ whole, choc.)	8floz														
Sherbet (fruit flavors, Land O'Lakes, orange), ice milk	1/2cup														
Shake (chocolate/peach/strawberry/vanilla)	1shake														
Sundae (hot fudge/strawberry)	1sundae														
Yogurt (non/ low/ whole fat)	1cup														
Bread/cereal/grain/starches															
Brown-rice	1/2cup														
Bread dressing	1/2cup														
Cereal; Granola or other grains	1 cup														
Cold breakfast cereal	11/4cup														
Cooked cereals (oatmeal, etc.)	1/2cup														
Chinese noodles; Include wheat flour string	1 Bowl														
Dasheen (Taro)	½														
Dark bread, wheat flour bread	1slice														
Dinner rolls or buns, white bread	1														
English muffins, bagel, rolls	1/2medium														
Gluten, fried	20g														
Muffin, biscuits, or corn bread	1small														
Noodles (Pasta/ Spaghetti w/o sauce)	1/2cup														
Nachos	1serving														
Pancakes, waffles	1,4"diameter														
Pizza	1medium														
Steamed bread	1medium														
White rice	1/2Bowl														
Legumes/ beans /seeds and nuts															
Beans, such as baked beans, pintos, kidney beans or chili, lima beans	1/2 cup														
Green beans, peas, snow peas and others	1/2cup														

Food list	Serving Size	How often?													
		never	**Times/month**			**Times/week**						**Times/day**			
		0	1	2	3	1	2	3	4	5	6	1	2	3	4+
Legumes/ beans /seeds and nuts															
Peanut, peanut butter	1oz, 2Tb														
Soybean curd (tofu) (soft/ dried/ fried/ fermented)	1/2cup														
Soybean, fresh without pod	1cup														
Soybean milk	1 cup														
Meat and poultry products															
Beef	2-3oz														
Croissandwich (cheese/egg/sausage)	1														
Chicken or turkey w or w/o skin	2-3oz														
Chicken eggs	1large														
Fast food burger (large/junior) (Fish/ Chicken/ Pork/ Beef)	1														
Ham/ Chinese ham	1slice														
Hot dogs w or w/o bun	2														
Lamb (mutton)	3.5oz														
Liver (chicken, pork, beef)	3.5oz														
Luncheon meat (bologna, etc.)	1slice														
Meat balls, Swedish	2-3oz														
Meat loaf	4oz														
Pig's blood, cooked	3.5oz														
Pig's feet	1oz														
Pig's large intestine	3.5oz														
Pork or fish dried and crushed	1Tb														
Pork(fat-trimmed loin, shoulder and butt)	1oz														
Pork ribs, lean	3.5oz														
Pork fat	3.5oz														
Pork medium fat (Bacon, etc.)	3.5oz														
Pork sausage (Chinese/ USA)	1link														
Fish and marine products															
Cuttle fish; squid	3oz														
Dark meat fish(salmon, mackerel, swordfish)	3oz														
Kelp	3.5oz														
Laver dried	3.5oz														
Lobster	3oz														
Other fish without dark meat fish	3oz														
Sardines	2														
Shellfish (clam/ crab, oyster, etc.)	9small/3oz														
Shrimp or (small/ dried)	3oz, 10g														
Small fishes (steamed/ dried)	10g														

Food list	Serving Size	How often?													
		never	**Times/month**			**Times/week**						**Times/day**			
		0	1	2	3	1	2	3	4	5	6	1	2	3	4+
Vegetables															
Asparagus (cooked/ canned/ frozen)	6spears														
Broccoli (USA/ Chinese)	3.5oz														
Cabbage (coleslaw/ pe-tsai/ sauerkrant)	1cup														
Carrots	1/2cup														
Celery	4-in stick														
Corn	1/2cup														
Cucumber, zucchini, Summer/winter squash	1/2cup														
Dark leaf greens; (spinach/ kale/ Mustard green/green potato leaves)	3.5oz														
Garland chrysanthemum	3.5oz														
Green pepper/ pepper paste	1/2cup/ 1T														
Lettuce	1cup														
Lily flower, dried	3.5oz														
Mushrooms (USA/ Chinese)	1/2cup														
Onions, green onion, scallions	3.5oz														
Parsley	1/4cup														
Potato (baked, boiled/ mashed/ fried/ French fries/ hash brown); w gravy	1or 1cup/ 10 pieces														
Pumpkin ,sweet potato, yam (mashed)	1/2cup														
Tomatoes (raw/ sauce)	1,1cup														
Vegetable juice (tomato juice, etc.)	1bottle														
Oils/Fat															
Butter; Margarine; Mayonnaise	1T														
Lard – refined (pork fat)	1T														
Plant oil (olive, palm, peanut , soybean)	1T														
Sesame oil	1T														
Vegetable oil (safflower, sunflower, corn)	1T														
Fruit															
Apple(raw/ juice, cider/ sauce)	1,4floz,1/2cup														
Apricot, peaches, plums	3medium														
Avocado	1medium														
Banana	1medium														
Citrus (oranges, tangerines, grapefruit)	1														
Carambola	1medium														
Guava	½														
Lemon	1medium														
Litchi (lychee)	5														
Mango, Papaya	1medium														
Melons (watermelon, Honeydew, Cantaloupe)	1slice, 1cup														
Mixed fruit (cnd)	1/2cup														
Orange juice or others: _____	4floz														
Pear (raw, cnd, light syrup)	1medium														

Food list	Serving Size	How often?													
		never	**Times/month**			**Times/week**						**Times/day**			
		0	1	2	3	1	2	3	4	5	6	1	2	3	4+
Fruit															
Pineapple	1cup														
Strawberries, cherries, blueberries	1/2cup														
Beverages															
Beer	12floz														
Black tea, leaves	1tea bag														
Carbonated beverage (cola / diet)	12floz														
Coffee w or w/o creamer; sugar	8floz														
Green / jasmine tea, leaves	1cup														
Wine (red/white); liquid	3.5floz														
Sweets, baked goods															
Brownies or dessert bars	1large														
Cake, cheese cake, coffee cake	1slice														
Candy/ candy bar	1.5oz														
Chocolate, sweet	1.45oz														
Cookies, (chocolate chip, etc)	1cup														
Pie	1slice														
Sweet roll, doughnuts, pastry	1roll														
Miscellaneous															
Instant noodles (brand:_____)	1 package														
Onion rings	7rings														
Sauce (barbecue/honey dipping/ ranch dipping/ sweet & sour dipping/ tartar dipping); Tomato katchup; Mustard	1Tb														
Salad dressing (blue cheese/ French/ Italian/ ranch/ thousand island)	1Tb														
Taco (Burrito, Fajita)	1Taco														
Tortilla chips, popcorn, crackers	1oz														
Jams, jellies, syrup, honey	1Tb														

APPENDIX-G

UNITED STATES FOOD FREQUENCY QUESTIONNAIRE

Food Frequency Questionnaire

Code#: Date:

Please indicate how much and how often you have eaten the following foods ***after*** *coming* to the U.S. When answering think about your usual diet over the past months. Please considers the serving size and marks how many servings you eat under the column" how often".For example, if you have 2 cups (16 fluid oz) of milk at one meal and 1 time per day, mark "2" at the "Column 1" under"Times/day".

Food list	Serving Size	**How often?**													
		never	**Times/month**			**Times/week**						**Times/day**			
		0	1	2	3	1	2	3	4	5	6	1	2	3	4+
Dairy product															
Cottage cheese, ricotta	1/2cup														
Cream cheese	1Tb														
Other cheese – Cheddar, Swiss	1slice														
Cream (whipping cream)	1T														
Ice cream, frozen yogurt	1cup														
Milk (skim/ 1%/ 2%/ whole, choc.)	8floz														
Sherbet (fruit flavors, Land O'Lakes, orange), ice milk	1/2cup														
Shake (chocolate/peach/strawberry/vanilla)	1shake														
Sundae (hot fudge/strawberry)	1sundae														
Yogurt (non/ low/ whole fat)	1cup														
Bread/cereal/grain/starches															
Brown-rice	1/2cup														
Bread dressing	1/2cup														
Cereal; Granola or other grains	1 cup														
Cold breakfast cereal	11/4cup														
Cooked cereals (oatmeal, etc.)	1/2cup														
Chinese noodles; Include wheat flour string	1 Bowl														
Dasheen (Taro)	½														
Dark bread, wheat flour bread	1slice														
Dinner rolls or buns, white bread	1														
English muffins, bagel, rolls	1/2medium														
Gluten, fried	20g														
Muffin, biscuits, or corn bread	1small														
Noodles (Pasta/ Spaghetti w/o sauce)	1/2cup														
Nachos	1serving														
Pancakes, waffles	1,4"diameter														
Pizza	1medium														
Steamed bread	1medium														
White rice	1/2Bowl														
Legumes/ beans /seeds and nuts															
Beans, such as baked beans, pintos, kidney beans or chili, lima beans	1/2 cup														
Green beans, peas, snow peas and others	1/2cup														

Food list	Serving Size	How often?														
		never	**Times/month**			**Times/week**						**Times/day**			
		0	1	2	3	1	2	3	4	5	6	1	2	3	4+
Legumes/ beans /seeds and nuts															
Peanut, peanut butter	1oz, 2Tb														
Soybean curd (tofu) (soft/ dried/ fried/ fermented)	1/2cup														
Soybean, fresh without pod	1cup														
Soybean milk	1 cup														
Meat and poultry products															
Beef	2-3oz														
Croissandwich (cheese/egg/sausage)	1														
Chicken or turkey w or w/o skin	2-3oz														
Chicken eggs	1large														
Fast food burger (large/junior) (Fish/ Chicken/ Pork/ Beef)	1														
Ham/ Chinese ham	1slice														
Hot dogs w or w/o bun	2														
Lamb (mutton)	3.5oz														
Liver (chicken, pork, beef)	3.5oz														
Luncheon meat (bologna, etc.)	1slice														
Meat balls, Swedish	2-3oz														
Meat loaf	4oz														
Pig's blood, cooked	3.5oz														
Pig's feet	1oz														
Pig's large intestine	3.5oz														
Pork or fish dried and crushed	1Tb														
Pork(fat-trimmed loin, shoulder and butt)	1oz														
Pork ribs, lean	3.5oz														
Pork fat	3.5oz														
Pork medium fat (Bacon, etc.)	3.5oz														
Pork sausage (Chinese/ USA)	1link														
Fish and marine products															
Cuttle fish; squid	3oz														
Dark meat fish(salmon, mackerel, swordfish)	3oz														
Kelp	3.5oz														
Laver dried	3.5oz														
Lobster	3oz														
Other fish without dark meat fish	3oz														
Sardines	2														
Shellfish (clam/ crab, oyster, etc.)	9small/3oz														
Shrimp or (small/ dried)	3oz, 10g														
Small fishes (steamed/ dried)	10g														

Food list	Serving Size	How often?													
		never	**Times/month**			**Times/week**						**Times/day**			
		0	1	2	3	1	2	3	4	5	6	1	2	3	4+
Vegetables															
Asparagus (cooked/ canned/ frozen)	6spears														
Broccoli (USA/ Chinese)	3.5oz														
Cabbage (coleslaw/ pe-tsai/ sauerkrant)	1cup														
Carrots	1/2cup														
Celery	4-in stick														
Corn	1/2cup														
Cucumber, zucchini, Summer/winter squash	1/2cup														
Dark leaf greens; (spinach/ kale/ Mustard green/green potato leaves)	3.5oz														
Garland chrysanthemum	3.5oz														
Green pepper/ pepper paste	1/2cup/ 1T														
Lettuce	1cup														
Lily flower, dried	3.5oz														
Mushrooms (USA/ Chinese)	1/2cup														
Onions, green onion, scallions	3.5oz														
Parsley	1/4cup														
Potato (baked, boiled/ mashed/ fried/ French fries/ hash brown); w gravy	1or 1cup/ 10 pieces														
Pumpkin ,sweet potato, yam (mashed)	1/2cup														
Tomatoes (raw/ sauce)	1,1cup														
Vegetable juice (tomato juice, etc.)	1bottle														
Oils/Fat															
Butter; Margarine; Mayonnaise	1T														
Lard – refined (pork fat)	1T														
Plant oil (olive, palm, peanut , soybean)	1T														
Sesame oil	1T														
Vegetable oil (safflower, sunflower, corn)	1T														
Fruit															
Apple(raw/ juice, cider/ sauce)	1,4floz,1/2cup														
Apricot, peaches, plums	3medium														
Avocado	1medium														
Banana	1medium														
Citrus (oranges, tangerines, grapefruit)	1														
Carambola	1medium														
Guava	½														
Lemon	1medium														
Litchi (lychee)	5														
Mango, Papaya	1medium														
Melons (watermelon, Honeydew, Cantaloupe)	1slice, 1cup														
Mixed fruit (cnd)	1/2cup														
Orange juice or others: _____	4floz														
Pear (raw, cnd, light syrup)	1medium														

Food list	Serving Size	How often?													
		never	**Times/month**			**Times/week**						**Times/day**			
		0	1	2	3	1	2	3	4	5	6	1	2	3	4+
Fruit															
Pineapple	1cup														
Strawberries, cherries, blueberries	1/2cup														
Beverages															
Beer	12floz														
Black tea, leaves	1tea bag														
Carbonated beverage (cola / diet)	12floz														
Coffee w or w/o creamer; sugar	8floz														
Green / jasmine tea, leaves	1cup														
Wine (red/white); liquid	3.5floz														
Sweets, baked goods															
Brownies or dessert bars	1large														
Cake, cheese cake, coffee cake	1slice														
Candy/ candy bar	1.5oz														
Chocolate, sweet	1.45oz														
Cookies, (chocolate chip, etc)	1cup														
Pie	1slice														
Sweet roll, doughnuts, pastry	1roll														
Miscellaneous															
Instant noodles (brand:_____)	1 package														
Onion rings	7rings														
Sauce (barbecue/honey dipping/ ranch dipping/ sweet & sour dipping/ tartar dipping); Tomato katchup; Mustard	1Tb														
Salad dressing (blue cheese/ French/ Italian/ ranch/ thousand island)	1Tb														
Taco (Burrito, Fajita)	1Taco														
Tortilla chips, popcorn, crackers	1oz														
Jams, jellies, syrup, honey	1Tb														

APPENDIX-H

RECOMMENDED DIETARY ALLOWANCES IN THE UNITED STATES

Recommended Dietary Allowances[1] in the United States

Revised by 1989

		19~24 years old		25~50 years old	
		male	**Female**	**male**	**Female**
Weight[2]	***(kg)***	72	58	79	63
	(lb)	160	128	174	138
Height[2]	***(cm)***	177	164	176	163
	(in)	70	65	70	64
Average energy allowances[3] (Kcal)		2900	2200	2900	2200
Protein (g)		58	46	63	50
Vitamin A (μg RE)		1000	800	1000	800
Vitamin E (mg α-TE)		10	8	10	8
Vitamin C (mg)		60	60	60	60
Thiamin (mg)		1.5	1.1	1.5	1.1
Riboflavin (mg)		1.7	1.3	1.7	1.3
Vitamin B6 (mg)		2.0	1.6	2.0	1.6
Vitamin B12 (μg)		2.0	2.0	2.0	2.0
Calcium (mg)		1200	1200	800	800
Iron (mg)		10	15	10	15

1. The allowances, expressed as average daily intakes over time, are intended to provide for individual variations among most normal persons as they live in the United States under usual environmental stresses. Diets should be based on a variety of common foods in order to provide other nutrients for which human requirements have been less well defined.
2. Weights and heights of Reference Adults are actual medians for the U.S. population of the designated age, as reported by NHANES II.
3. In the range of light to moderate actively, the coefficient of variation is ± 20%.
4. Source: National Research Council. 1989. Recommended Dietary Allowances. Washington, D.C: National Academy Press.

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