Assessment of Risk Factors for Developing Type 2 Diabetes Mellitus in Hmong Americans from Dunn County, Wisconsin

by

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A Research Paper
Submitted in Partial Fulfillment of the
Requirements for the
Master of Science Degree
in

Food and Nutritional Sciences

Approved: 6 Semester Credits

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January, 2009

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Title: ***Assessment of Risk Factor for Developing Type 2 Diabetes Mellitus in Hmong Americans from Dunn County, WI***

Graduate Degree/Major: MS Food and Nutritional Sciences

Research Adviser: **Dr. Esther Fahm, PhD, RD, CFCS**

Month/Year: **January, 2009**

Number of Pages: **110**

Style Manual Used: **American Psychological Association, 5th edition**

ABSTRACT

The purpose of this study was to identify if the Hmong of Dunn County, Wisconsin have risk factors for developing type 2 diabetes mellitus. Thirty-one subjects (17 males and 14 females) from 18-60 years old participated in the study. Data was collected at the Dunn County Supplemental Nutrition Program for Women, Infants, and Children, and Hmong Stout Student Organization of University of Wisconsin-Stout. Subjects completed a survey which assessed risk factors for type 2 diabetes mellitus such as: age, weight status, smoking habits, eating habits, magnesium and fiber intake, physical activity, and past medical history. Height and weight of subjects were measured by the researcher, and body mass index (BMI) was calculated from these measurements. A quantitative food frequency questionnaire was administered to determine magnesium

and fiber intakes as well as consumption from several food groups. Data was analyzed using descriptive statistics such as the mean, Pearson correlation, and paired t test.

Results indicated 54.8% of subjects had inadequate fiber intakes (less than 66% of the Adequate Intake). The major sources of fiber included: fries, bananas, oats, chocolate milk, pork/ham, coconut cream, and candy bars. The majority of subjects had no risk associated with age, overweight, physical activity, magnesium intake or smoking habits. Past medical history of diabetes, high blood pressure, and high cholesterol were insignificant. No significant correlations existed between any of the risk factors studied.

In conclusion, the only risk factor associated with type 2 diabetes found in this study was inadequate fiber intake. Hmong subjects of this study may need to increase their fiber intake to at least 16.5 g of fiber per day (66% of the Adequate Intake). The primary source of fiber consumed may suggest a small degree of acculturation.

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Acknowledgements

I would like to thank God for giving me the strength and perseverance to complete this thesis. Secondly, I would like to thank my parents Dave and Rose as well as my siblings Joanna and Brian, and my extended family for their continuous support, prayers and words of encouragement throughout these last two years.

To Mike Christopherson, my husband, thank you for showing your never-ending love by being there always and believing in me when I did not believe in myself.

I would like to thank Dr. Esther Fahm for spending so much precious time with me on this project and for helping me through the rough spots. I could not have done this without you! To my committee members, Dr. Carol Seaborn and Dr. Ann Parsons, thank you for taking time out of your very busy lives to read my thesis and give me your very valued opinions.

To the volunteers of this project, thank you for giving me the use of your time to help me with data collection at the WIC clinic and Hmong Stout Student Organization (HSSO) meetings, I definitely could not have been able to handle three months of data collection by myself. To the participants, thank you for also giving me your time to analyze your population. This thesis would not exist if it were not for your contribution to this project. Thank you for your time.

To Annie, Diane and Cheri, thank you for your encouragement, your guidance, and true friendship throughout these last two years. You made this experience worth the many late nights and weekends in front of the computer!

TABLE OF CONTENTS

List of Tables

List of Figures

Chapter I: Introduction

The Hmong American population in the United States came primarily from the northern mountainous regions of Laos, Thailand, and Vietnam. In these regions, they lived in isolated villages where they hunted, farmed, and fished to nourish themselves. Slash-and-burn agriculture was used, which is a system where patches of a forest are burned and cleared for cultivation of crops for a period of time; however, productivity becomes depleted causing another patch of forest to be burned and cleared. This form of agriculture caused the Hmong to move to new areas of the mountains every four to six years. Their migration created isolation from other villages, therefore allowing the Hmong to maintain a strong, independent geographical, cultural, and social identity. The slash-and-burn agriculture was also a physically demanding lifestyle, because Hmong farmers had no access to animals or machinery to help farm. All family members were involved in this production essentially to thrive as a culture.

Culhane-Pera, Vawter, Xiong, Babbit, and Solberg (2003) documented that the Hmong people have immigrated to the Unites States because of their involvement in the "secret war" with the United States CIA (Central Intelligence Agency) against the Vietnamese and Laotian communists. The secret army was primarily Hmong who were trained to fight the North Vietnamese bringing them to a standstill which greatly helped the United States. This collaboration with the United States caused them to be singled out by the Vietnamese and Pathet Lao communists after the battle. This persecution produced many fatalities within the Hmong population, so they fled to refugee camps in Thailand. Hmong refugees have since immigrated to the United States and other countries. This historical perspective is important for healthcare workers to understand. In general, Hmong have distrust of Americans for the suffering they have

undergone mentally and physically. They have been forced out of their original homes and must interact with the cultural clashes that go with relocation.

Immigration has caused confusion and acculturation of the Hmong people. Thus, attitudes toward traditional beliefs have changed. Culhane-Pera et al. (2003) emphasized that it is important to understand that traditionally the Hmong are a patriarchal society; therefore Hmong men have more power and decision making authority than the women. However, in the United States Hmong women are having leadership roles in the community and in the household, creating stress between men and women due to adjusting and understanding their new roles and responsibilities. For instance, many food purchases are thus done together or with the entire family.

Due to the places the Hmong are being resettled such as in Wisconsin and Minnesota, Hmong do not have the same varieties of food as in the mountains of Southeast Asia. Acculturation has also caused family members to increasingly desire American food, which is dramatically different than the Hmong traditional diet. There have been health problems related to this change in diet. Specifically, for the Hmong, the development of type 2 diabetes mellitus has been a growing concern in Wisconsin according to Her and Mundt (2005).

The Hmong traditional diet, according to Ikeda et al. (1991), was not contributable to type 2 diabetes mellitus. The diet was high in complex carbohydrates. Traditional crops were mustard greens, pumpkin, rice, beans, and corn. Meat was eaten, but not on a regular basis. Bananas and bamboo shoots were gathered from the forest. Foods were prepared with the equipment available, thus Hmong women currently and historically have never used measuring devices such as measuring cups or measurements such as ounces, cups, and teaspoons when preparing a meal. Therefore, portion size has not been clearly defined for this population. Ikeda

et al. (1991) suggested that when asking Hmong about portions of food consumed, the best way to have an accurate response would be to have food models present so they can judge accordingly.

Acculturation has caused a nontraditional diet to thrive for many reasons such as exposure, convenience, income, and likeability. Hmong children are exposed through their lunch and breakfast at school, especially if they are involved in the National School Lunch and Breakfast Programs. These are federally funded programs in which families can receive free or reduced lunch/breakfast if they meet the income eligibility requirements. This exposure to Americanized meals creates likeability for the food and thus requests for it at dinner time. In some cases, American food is a convenience during traveling. Income can play a big role in most people's diet. In some cases, Hmong are better off in the United States than in Southeast Asia, and they may eat food such as meat that is not eaten traditionally or only on special occasions. In cases of low income, some families turn to food shelters which contain food that is highly processed and different than the traditional diet.

The Hmong have immigrated to places different from their homeland. This drastic change in environment has forced the Hmong to learn how to survive in this country on what is available to them. Immigration has caused a change in traditional diet, roles in the family, and ways of gaining education. This change in culture has come with consequences such as in the erosion of cultural and dietary traditions. According to Her and Mundt (2005), the change in their traditional way of living to an industrialized society may have contributed to increased risk of developing type 2 diabetes mellitus.

The American Diabetes Association *Guide to Diabetes Medical Nutrition Therapy and Education* (Ross, Boucher, and O'Connell, 2005) listed the major risk factors for type 2 diabetes

mellitus as: age ≥45 years, ethnicity, family history, habitual physical inactivity, overweight (BMI ≥25 kg/m^2), hypertension (≥140/90 mm Hg in adults), previously diagnosed impaired fasting glucose or impaired glucose tolerance, HDL cholesterol (< 35mg/dL) and/or triglyceride level (> 250 mg/dL), polycystic ovary syndrome, and history of vascular disease.

According to Lebovitz (2004), overweight and obesity is a risk factor for developing type 2 diabetes. The best measure of overweight and obesity is the body mass index (BMI). Overweight status, a BMI of equal to or greater than 25 kg/m^2, and obesity, a BMI greater than or equal to 30 kg/m^2, have become a problem throughout the U.S. BMI levels of this proportion cause an increased risk of developing many types of chronic diseases, including type 2 diabetes mellitus. In fact, the term "diabesity" has been used to demonstrate the close link between type 2 diabetes mellitus and obesity.

Smoking has been linked to diabetes by Nakamishi, Nakamura, Matsuo, Suzuki and Tatara (2000). In this 5-year study of 1266 male Japanese office workers, 87 developed impaired fasting glucose and 54 men developed type 2 diabetes mellitus. They found that the number of cigarettes smoked per day as well as exposure to second hand smoke was associated with development of the disease in these men. Therefore, Wannamethee, Shaper, and Perry (2001) concluded that smoking is considered a risk factor for developing type 2 diabetes mellitus.

Statement of the Problem

According to the U.S. Department of Health and Human Services Centers for Disease Control and Prevention (2007), diabetes has dramatically increased in recent years reaching 23.6 million in 2007. Although many Americans have diabetes, 5.7 million do not know they have this disease. Type 2 diabetes is a new disease for the Hmong culture and many Hmong do not know they have diabetes. In a recent national health survey performed by McNeely and Boyko

(2004), the Asian American population, with age, BMI, and sex adjusted, were at a 60% greater risk of acquiring diabetes than non-Hispanic whites. A Wisconsin pilot study by Her and Mundt (2005) was the first study to quantify the proportion of Hmong with an increased risk for developing type 2 diabetes mellitus. The study found that 41% of the 144 Hmong sampled were at an increased risk.

Due to the growing problem of type 2 diabetes mellitus in the United States, it is important to understand the length of time living in the United States and how it may affect the lifestyle patterns that increase risk of the disease in the Hmong population. This problem may be due to contributors such as decreased physical activity and deviation from a traditional diet. An expert in the field (Chang, 2005) stated the following:

> Although rice and vegetables are still considered staples for most Hmong-American families, meat has become a regular menu item; more dishes are also available at mealtime; more food is consumed per individual; and communal dining is being replaced by more individualized meals. (p. 1)

It is known that diet and lifestyle choices can prevent type 2 diabetes mellitus. There have been numerous studies on the association between magnesium and fiber and their inverse relationship with type 2 diabetes mellitus. Song, Manson, Buring and Liu (2004) demonstrated an inverse association in middle-aged women between magnesium intake and the risk for developing type 2 diabetes mellitus. The inverse relationship between magnesium and the risk for developing type 2 diabetes mellitus was also found by Schulze, et al. (2007). Gross, Li, Ford and Liu (2004) discovered that refined carbohydrate consumption (low dietary fiber) increases the risk for obesity and type 2 diabetes. Whereas, Shulze, et al. (2004) reported increased cereal and fruit fiber consumption was associated with a low risk for type 2 diabetes mellitus. The

change in the Hmong diet and the increase of type 2 diabetes mellitus in the population may be due to lifestyle changes in diet and exercise. This study will attempt to explore these lifestyle changes and the risk of type 2 diabetes.

Purpose of the Study

The purpose of this study was to identify if Hmong living in Dunn County, Wisconsin have a risk for developing type 2 diabetes mellitus by identifying the prevalence of several risk factors that may be associated with developing type 2 diabetes, including:

- Overweight or obesity
- Dietary factors: the frequency of use of food groups and daily intakes of magnesium and fiber
- Lifestyle factors: physical activity level and cigarette smoking habits
- Health factors: family medical history of type 2 diabetes, and self report of type 2 diabetes, and blood cholesterol level.

Several objectives were identified for meeting the purpose of the study. They are as follows:

Objective 1: Determine the frequency of food items eaten and daily amounts consumed by using a quantitative food frequency questionnaire.

Objective 2: Determine the adequacy of magnesium and fiber intakes by comparisons with dietary recommendations.

Objective 3: Examine the relationship of the duration of time living in the U.S. to the frequency of food groups typically eaten as well as to magnesium and fiber intakes.

Objective 4: Classify the body weight status of Hmong subjects and determine the frequency of overweight and obesity by using body mass index (BMI) standards.

Objective 5: Determine the physical activity level of Hmong subjects compared to the recommendation for daily physical activity level for adults.

Objective 6: Determine the frequency of other risk factors associated with type 2 diabetes: the age of the subjects (45 years or older), cigarette smoking, family medical history of diabetes, personal history of diabetes, hypertension and high cholesterol.

Assumptions and Limitations of the Study

With human involvement, there are limitations and assumptions that exist when performing research; this study is no exception. Therefore these assumptions and limitations are identified in this section. It will be assumed that the population will answer the food frequency questionnaire honestly, as well as understand the questions presented with the assistance of an interpreter. A limitation to this study includes a language barrier between the researcher and some of the participants. Another limitation consists of answers which may be given by the participant in a way he/she perceives the response would be admired by the researcher. This study examined the frequency of selected risk factors for developing type 2 diabetes and no effort was made to determine if Hmong were at an increased risk for type 2 diabetes due to residing in the U.S. for a period of time. The primary limitations to this study were the sample size of 31 subjects and the use of a convenience sample which limits generalizing the results of this study. The age range of subjects studied was 18 to 60 years old. If the group was more homogenous in age it may have been more feasible to generalize. The study did not determine subjects at risk for type 2 diabetes, instead it found differences in frequencies. No pilot test of the instrument was administered and a convenience sample was used, which are additional methodological limitations of this research.

Definition of Terms

There are a few terms used commonly in this study that need to be defined for a more complete knowledge of the study. These are:

Acculturation- Is defined by Mish (2000) as: "1: Cultural modification of an individual, group, or people by adapting to or borrowing traits from another culture; also: a merging of cultures as a result of prolonged contact. 2: the process by which a human being acquires the culture of a particular society from infancy." (p. 8)

Adequate fiber intake- Is defined as eating at least two-thirds of the adequate intake for fiber of 25 g/day because it was the minimum adequate intake needed to include both males and females.

BMI (Body Mass Index)- Is defined by Lee and Nieman (2003) as "weight in kilograms divided by height in meters squared (kg/m^2). The most widely used weight height or power-type index." (p. 561)

Hmong- Is defined by Mish (2000) as: "1: A member of a mountain-dwelling people inhabiting southeastern China and the northern parts of Vietnam, Laos, and Thailand. 2: The language of the Hmong people" (p. 550).

Hmong American- A U.S. citizen or resident of Hmong descent.

Shamanism- Is defined by Mish (2000) as "A religion practiced by indigenous peoples of far northern Europe and Siberia that is characterized by belief in an unseen world of gods, demons, and ancestral spirits responsive only to the shamans" (p. 1073)

Type 2 diabetes mellitus – Defined by Mahan and Escott-Stump (2004) as "a type of diabetes usually occurring in persons older than 30 years of age, previously known as non-insulin-dependent diabetes mellitus (NIDDM) or maturity-onset diabetes: now also frequently

diagnosed in youth and young adults; formerly called *maturity onset diabetes of youth (MODY).*" (p. 793)

Methodology

A survey was conducted involving Hmong participants in the Dunn County Supplemental Nutrition Program for Women, Infants, and Children (WIC) and Hmong students enrolled at the University of Wisconsin-Stout. The survey was conducted over a period of three months beginning in February, 2007 and ending May, 2007. The survey data collected included demographic information, height, weight, medical history, and lifestyle factors such as physical activity and smoking. A quantitative food frequency questionnaire was also collected which included food groups such as fruit, vegetables, dairy, grains, drinks, condiments, and miscellaneous foods that are common to both the traditional Hmong population as well as Americans. Data was analyzed using SPSS version 14. Descriptive statistics were used for food frequency and demographic information. A Pearson correlation was performed on all risk factors. An independent t- test was used to compare the differences between the frequencies of subjects with risk factors to those without risk factors of type 2 diabetes mellitus.

Chapter II: Literature Review

This chapter will include an in-depth discussion on Hmong traditional beliefs and the conflicts they have with Western medicine, followed by a discussion of traditional diet practices and those of acculturation. Diabetes will be explained by definition, risk factors, and will clarify Hmong risk for the disease. Next, different dietary substances will be explored on their ability to lower diabetes risk.

Hmong Traditional Beliefs versus Western Medicine

Mish (2000, p. 534) defined health as "the condition of being sound in body, mind, or spirit." This definition is considered correct by western medicine standards. However, the Hmong culture has a different approach to the idea of health. According to Ikeda et. al. (1991), the health beliefs of the Hmong are undividable from spiritual beliefs. Therefore, most of the illnesses in the culture are viewed as problems in the spiritual world. Some illnesses can be cured by a shaman healer or herbalist. A shaman healer is a person, male or female, who mediates between the spiritual world and the person he/she is helping by negotiating with the spirit through a trance. This intervention is believed to restore the health of the ill person. An herbalist is a person who has expertise in herbs for medicinal purposes. The first remedy usually attempted by an ill person is herbs and if that remedy does not work; a shaman is notified. For type 2 diabetes mellitus, a shaman is not used because the disease is not considered a spiritual disease.

Western medicine contains many procedures that culturally conflict with the Hmong culture. For instance, there are operations, medications, transfusions, organ donations and transplantations. Culhane-Pera et al. (2003) noted that a common concern of the Hmong is their blood. Many Hmong worry too much blood will be drawn resulting in death. Her and Culhane-

Pera (2004) also suggest that Hmong believe that drawing blood will invite negative occurrences. Thus, important blood testing for diseases such as in diabetes is often refused. Therefore, some Hmong people may never know if they have the disease. With these cultural beliefs, many Hmong do not understand the chronic disease of diabetes. Helsel, Mochel, and Bauer (2004) explained that there are no natural or spiritual reasons for diabetes mellitus. In fact, Hmong do not have a word for diabetes. The closest word they have is "sweet blood". In Laos, many Hmong claim diabetes did not occur because they would have died or would have been cured.

Culhane-Pera et al. (2003) explained that medications are also a concern. Many Hmong have two worries about medications. One worry is that Western medicine is too strong for their bodies. The second worry is that physicians give them lower grade medications compared to Americans. Hmong patients will however take medications for illnesses such as the flu. Her and Culhane-Pera (2004) explained that medicine used for a long time such as in diabetes mellitus where the patient does not feel ill is of a concern for the Hmong people. Traditionally, Hmong believe that they have been cured by a remedy; therefore recovery from an illness should be relatively short. Experiences of antibiotic treatments in refugee camps also have an effect on the belief of a short recovery. Short recovery is not the case with diabetes mellitus.

Traditional Diet

Ikeda et al. (1991) described the Hmong traditional diet as consisting of many complex carbohydrates and limited refined carbohydrate products. A typical meal always consisted of rice and included vegetable greens such as mustard greens. Meat such as chicken, pork or beef was consumed when available. The variety of rice most preferred by the Hmong in California was medium-grained unenriched rice called Calrose. Homemade tofu made of soybeans was a major source of calcium which was consumed often in the traditional Hmong diet. Fruits that were

commonly eaten include: jackfruit, mango, papaya, guava, pineapple, and coconut. Mustard greens were common leafy vegetables eaten daily by the Hmong. Other vegetables consisted of various varieties of pumpkins, gourds, squash, and eggplant. Herbs, spices, and seasonings commonly used were: lemongrass, coriander, cilantro, garlic, dill, ginger, Thai chili peppers, green onions, lemon and lime juice, soy sauce, fish sauce, monosodium glutamate, and salt. Thus the traditional Hmong diet did not typically contribute to chronic diseases such as type 2 diabetes mellitus.

Ikeda (1992) reported that traditional cooking techniques of the Hmong were generally healthy. They consist of boiling, grilling, stir-frying, and steaming. Baking was not used much traditionally; therefore few baked goods and casseroles were made. It is also important to note that measuring cups or spoons were not typically used.

Hmong American Dietary Studies

Meal patterns and food groups were studied to determine the dietary trends of Hmong Americans and perhaps the types of food they may be willing to introduce into their diet. Ikeda et. al. (1991) examined the food habits of Californian Hmong Americans. They found that 52% of the people sampled consumed two meals a day and 47% consumed three meals per day. These meals were eaten in a style where the food was set in the center of the table and typically eaten with spoons and forks in which the family members could feed themselves. Seventy-nine percent of families ate together at the same table for a meal. The majority of Hmong American children consumed 3 to 4 meals per day in which 90% received free school lunch. Typically, a diabetic should eat 5 meals a day with snacks consisting of 2 carbohydrate choices from the diabetic exchange list and 3 to 4 carbohydrate choices with meals. Therefore, if a Hmong American adult

did have type 2 diabetes mellitus then the meal pattern of 2 or 3 meals per day without snacking would not aid in controlling their blood glucose concentration in a healthy target range.

Ikeda et al. (1991) also determined that dairy products have been sampled by Hmong homemakers however only 31% of them enjoyed the taste of milk. Cheese was determined to be less familiar than milk. This information was confirmed in a 24-hour food recall from each of the homemakers. However, an interest in using and storing dairy products was indicated by over 90% of homemakers. Chang (2005) reported that the dairy group was the least correctly identified of all food groups.

Chang (2005) also reported that the vegetable group was the most identified food group for Hmong people. However, fruit was the second least identified food group. Ikeda et al. (1991) discovered that Hmong Americans consumed many different varieties of foods that were not available in American grocery stores. Asian American supermarkets have supplied some of these foods packaged in cans rather than fresh. The fresh varieties such as guava, pineapple and mango were available but at a high price. For economic reasons, there has been less consumption of these traditional fruits. During the immigration process, the Hmong were allowed to bring over seeds of their native vegetable plants so some remain in their diet today with the help of community gardens. Freshness of all food was valued by the Hmong. Therefore, when possible they consume fresh produce.

Meat consumption was also reported by Ikeda et al. (1991). In this study pork was the preferred choice of meat by the Hmong because it was mentioned 191 times in the food recalls. It was reported that Hmong families would purchase an entire hog and feed themselves for a month off of the animal. Chicken was also consumed often; however, turkey was not eaten as often. Beef was eaten but not as often as pork or chicken. Fish was consumed most commonly (50%)

when caught by male family members. Other hunted animals included deer, squirrel, and pheasant. Deer was the most commonly hunted of the 44% who hunted. Mung beans and soy beans were the only well known varieties of dried peas and beans. Chang (2005) identified that 80% of subjects tested correctly identified the meat food group. Meat was a well known food group and may be eaten more by the Hmong in America due to a plethora of possibilities.

The grain food group is important for fiber and carbohydrates. These products are generally fortified with vitamins and nutrients. Chang (2005) discovered that grain products were correctly identified by over 80% of the Hmong subjects. Rice was determined to be the staple of the Hmong diet because it was eaten at every meal in the Ikeda et al. (1991) study. An average of 2.3 servings of rice was reported per person per day. Cereal was eaten by children mostly in the Supplemental Nutrition Program for Women, Infants, and Children (WIC) or the School Nutrition Program. However, bread was not consumed regularly. In fact, 66% of subjects did not know that a variety of breads were sold at the supermarket.

Beverages are known for being pertinent in keeping bodies hydrated. Ikeda et al. (1991) noted that the beverage consumed most often by the Hmong living in central California was broth from cooked vegetables. Actually, mugs or cups were not a common place-setting at mealtime. Therefore, the broth was sipped from bowls of which the vegetables were eaten. The second most common beverage was water. When thirsty, 86% specified that they would consume water. As far as juices, orange and apple juices were consumed a few times but not as often as broth or water. Soft drinks were only purchased by those who could afford them. It would be beneficial to understand if this pattern of food consumption has persevered in the last 15 years. If sweetened beverage consumption has increased it may be a risk factor for type 2 diabetes mellitus.

Type 2 Diabetes Mellitus

There are many different types of diabetes but the one of interest for this study is type 2 diabetes mellitus. Type 2 diabetes is the most common in adults and is rising in prevalence among Americans. Historically, type 2 is referred to "adult-onset" or "non-insulin dependent" diabetes. However, type 2 diabetes mellitus is the term used currently.

The etiology is unknown for type 2 diabetes mellitus. Ross, Boucher and O'Connell (2005) explained diabetes can develop from abnormal action and secretion of insulin which causes hyperglycemia (elevated blood glucose level). Insulin is a hormone that is secreted by the islet cells of the pancreas. Insulin is released when an increase of blood sugar is detected. The insulin then binds. to insulin receptors in various parts of the body such as in the adipose, muscle and liver. Once insulin binds to the insulin receptor, other receptors are activated and bind glucose and allow glucose (sugar) to enter the cells, thus feeding the cells. Type 2 diabetes may be diagnosed by measuring glucose concentration in the blood. Lebovitz (2004) described the criteria for diagnosing diabetes as having a blood glucose concentration of 200 mg/dl or greater at any time of day regardless of last time food was eaten. Symptoms of diabetes include: polyuria (frequent urine), polydipsia (frequent thirst), polyphagia (excessive eating), and unexplained weight loss. Other tests may be performed to determine the disease; however, they must be confirmed by repeating tests on a separate day. If diabetes is uncontrolled, glucose remains elevated in the blood and over time causes detrimental effects to major organs. The Department of Human and Health Services Centers for Disease Control and Prevention (2007) reports that diabetes can cause many comorbidities such as heart disease, stroke, kidney failure, dental disease, pregnancy complications, blindness, lower-extremity amputations, and deaths related to flu and pneumonia.

Risk Factors for Developing Type 2 Diabetes

Although type 2 diabetes mellitus is a serious metabolic illness, this research paper intends to examine the lifestyle factors which are considered risk factors for developing type 2 diabetes in the Hmong population. Ross et al. (2005) explained there are major risk factors for type 2 diabetes which affect insulin sensitivity. Risk factors are: obesity, age, low physical activity level, ethnicity, family history, and hypertension.

Obesity is classified according to a calculation of body mass index (BMI). The BMI classifications from the Department of Health and Human Services, National Institutes of Health and National Heart, Lung and Blood Institute (n.d.), are as follows: <18.5 is underweight, 18.5-24.9 is normal weight, 25-29.9 is overweight, 30-34.9 is obesity class I, 35-39.9 is obesity class II, >40 is obesity class III. Ross, et al. (2005) state that obesity, measured as a weight greater than 120% of desirable body weight, is true of approximately 90% of patients diagnosed with type 2 diabetes. In fact, there was a study performed by Himes, Story, Czaplinski, and Dahlberg-Luby (1992) which concluded that the low income Hmong children, an otherwise low risk population for obesity, demonstrated early obesity. Subjects had their height, weight, and other anthropometric measurements collected for the study. The results showed their weight-for-height (BMI) status significantly surpassed the national median as well as increased with age indicating obesity was a problem after three years of age. Chang (2005) examined anthropometrics of Hmong Americans in the La Crosse and Wausau, Wisconsin areas with most subjects being 22.1±6.3 years old. The average BMI of subjects was 26.8±6.5. A BMI of 26 is classified as overweight. Overweight status indicates a risk for type 2 diabetes mellitus. It was concluded that Wisconsin Hmong Americans "may be adapting to the American lifestyle that is associated with overweight, obesity and increased risk of chronic diseases, such as diabetes mellitus and

cardiovascular disease." In fact McNeely and Boyko (2004) studied Asian Americans through the Behavior Risk Factor Surveillance Survey (BRFSS) which is performed by telephone to determine status of health and health behaviors in America and its territories of Guam, Puerto Rico and the Virgin Islands. Of the 163,584 subjects, 3,071 were of Asian descent. They found that 62.4% of these individuals were a normal weight, 32.8% were overweight and 4.8% were obese. The average BMI was 24.0±0.2. The researchers concluded that after adjusting for age, sex and BMI, Asian Americans had a 60% higher prevalence of type 2 diabetes mellitus than non Hispanic whites. However, Asian Americans had 20-30% lower prevalence of type 2 diabetes mellitus than African American, Hispanic, or American Indians.

There is contradicting evidence in using the BMI level to classify overweight Asian populations. Some researchers suggest that the BMI level for Asians should be lower than the American standard due to the relatively short stature and high visceral adipose tissue among the Asian population. Yong-Woo, Allison, Heymsfield, and Gallagher (2001) concluded that higher amounts of visceral adiposity tissues exists in healthy Asian Americans, which implies values for white Americans may not apply to Asian Americans. Another study by Wang, et al. (1994) indicated BMI classification differences through comparing anthropometries (height and body weight) of whites and Asian Americans. This study demonstrated that Asians had more upper-body subcutaneous fat and a different fat distribution than whites. However, Oh, Shin, Yun, Yoo and Huh (2004) concluded that middle-aged Koreans did not need a lower BMI cut-off point for defining overweight status. Koreans with a BMI of $\geq$25 did not exhibit greater risk of type 2 diabetes mellitus or other diseases than whites. Smoking is considered a risk factor for developing type 2 diabetes mellitus. Wannamethee, Shaper, and Perry (2001) examined smoking in a prospective study consisting of 7,124 British men without a history of diabetes, coronary

heart disease or stroke and smoked cigarettes in which a total of 290 developed diabetes mellitus. When comparing subjects who never smoked with those who smoked, with adjustment for age, smokers had a significantly higher risk of developing type 2 diabetes. Another study performed by Nakanishi et al. (2000) indicated that risk for impaired fasting glucose and type 2 diabetes by cigarette smoking increased by the number of cigarettes smoked per day and number of packs per year of exposure in a dose-dependent manner. The mechanism that cigarette smoking triggers or predisposes individuals to type 2 diabetes mellitus or impaired fasting glucose is unclear at this point.

Ross, Boucher and O'Connell (2005) explained that Asian-Americans and Pacific Islanders are at a greater risk for developing type 2 diabetes mellitus. The National Diabetes Information Clearinghouse (2007) also identified Asian Americans at an increased risk for developing type 2 diabetes. About 7.5% of Asian Americans 20 years or older had type 2 diabetes from 2004-2006. A study by Her and Mundt (2005) identified some risk factors for type 2 diabetes in Hmong adults in Wisconsin. They concluded that 41% of subjects were at an increased risk for developing type 2 diabetes mellitus. Due to the high significance level of subjects at an increased risk for developing type 2 diabetes mellitus, it may be true that some subjects already had the disease. This was the first study to examine the Hmong culture and their risk for type 2 diabetes mellitus.

Physical activity is defined by the Wisconsin Nutrition and Physical Activity Program (2005) as "any bodily movement produced by skeletal muscles resulting in energy expenditure." Physical activity is important in maintaining a healthy weight and reducing the risk of many chronic diseases including type 2 diabetes mellitus. Therefore, 30 minutes of moderate intensity physical activity is recommended most days of the week but preferred all days of the week. The

Department of Health and Human Services, Centers for Disease Control and Prevention (2008) reported physical activity requirements for adults as: moderate intensity physical activity for 30 minutes five or more days per week or vigorous intensity physical activity for 20 minutes three times per week or more. Also, the United States Department of Health and Human Services Centers for Disease Control and Prevention (2008) defined moderate physical activity as burning three and a half to seven calories per minute and vigorous physical activity as burning more than seven calories per minute. Moderate physieal activity refers to activities that compare to brisk walking. According to the Wisconsin Nutrition and Physical Activity program (2005) physical activity seems to vary with gender and educational level. Women are less likely (26%) to get regular physical activity than men (35%). Also, a person with a high school education is less likely (22%) to be regularly physical active than a college graduate (36%). Aecording to the 2005 BRFSS, only 56.6% of adults in Wisconsin obtained 30 or more minutes of moderate physical activity five or more days per week.

In the Finnish Diabetes Prevention Study by Lindström et al. (2003), lifestyle interventions on diet and physical activity were analyzed. The subjects of this study had to meet the World Health Organization (WHO) criteria for being at risk: 40-64 years old, a BMI of >25 kg/m^2, and two oral glucose tolerance tests in the impaired glucose tolerance range. Results indicated that prior to intervention subjects engaged in an average of 160 minutes of physical activity per week and when intervention was introduced the amount of total time spent being physically active did not change; however, the intensity of moderate to vigorous physical activity increased. The researchers concluded from this study that intervention can help prevent or postpone the development of type 2 diabetes mellitus. Ekelund et al. (2005) examined physical activity energy expenditure over 5.6 years and whether or not it predicted progression toward

metabolic syndrome. The subjects were both men and women averaging 53 years old who were free of the metabolic syndrome at the beginning of the study. It was concluded that "physical activity energy expenditure predicts the progression toward the metabolic syndrome in a dose dependent manner and that this association is not explained by obesity, level of aerobic fitness or other potential confounding factors."

Dietary Patterns and Risk for Type 2 Diabetes Mellitus

The role of diet and risk for developing type 2 diabetes mellitus has been explored recently. Van Dam, Rimm, Willett, Stampfer, and Hu (2002) studied 51,529 U.S. men who were involved in the Health Professionals Follow-up Study. Through the use of a semi-quantitative food frequency questionnaire data was collected and analyzed. Dietary patterns were determined as "prudent" or "westernized". The prudent dietary pattern contained an increased consumption of fruit, whole grains, vegetables, legumes, fish and poultry. However, the western dietary pattern contained an increased consumption of red meat, refined grains, processed meat, French fries, sweets and desserts, high-fat dairy products, eggs, and high-sugar drinks. The results indicated a modestly reduced risk of developing type 2 diabetes with the prudent dietary pattern even after adjusting for physical activity, cigarette smoking, hypercholesterolemia, hypertension, ancestry, alcohol consumption and family history of diabetes. The western diet had a considerably higher risk for developing type 2 diabetes mellitus and was independent of BMI, physical activity, age, and family history of diabetes. The researchers also concluded that when the western diet was in combination with physical inactivity or obesity there was a significantly high association with risk of type 2 diabetes mellitus.

Another study by Hodge, English, O'Dea, and Giles (2007) investigated dietary patterns and incidence of diabetes through a cohort study. Dietary information was also collected by use

of a self-administered food frequency questionnaire. Through factor analysis in 31,641 participants, two factors were significant in the development of type 2 diabetes. The first factor characterized by cooked vegetables and salad, demonstrated an inverse association with the development of diabetes. The researchers believe that foods such as whole grain bread, yogurt, chicken, and steamed fish, as well as shunning white bread may play a role in the inverse association that was found. Characteristics of the second factor including meats and fried foods demonstrated a positive association for developing diabetes. The researchers concluded that avoiding a diet high in meats and fried or fatty foods in addition to incorporating a variety of vegetables into a diet may aid in reducing the risk of type 2 diabetes mellitus.

Fiber and Risk for Type 2 Diabetes Mellitus

A low fiber diet has recently been linked to type 2 diabetes mellitus by several studies. Meyer et al. (2000) examined carbohydrates, dietary fiber and the incidence of type 2 diabetes in women. Through a food frequency questionnaire and with a proportional hazards regression the researchers found that total dietary fiber was inversely associated with risk for type 2 diabetes. Therefore a low fiber diet increases the risk for type 2 diabetes mellitus. It was also found that insoluble fiber was inversely associated with risk for type 2 diabetes whereas soluble fiber did not seem to be related to type 2 diabetes. Other food groups were analyzed that contained carbohydrates and it was found that only the grain group contributed to the inverse association with type 2 diabetes. Therefore, fruit, vegetable and legume intake were not strongly related to a risk for type 2 diabetes. This result was similar to other studies such as Schulze et al. (2004) who reported findings from the Nurses' Health Study II in which 116,671 middle-aged women were studied via a semi-quantitative food frequency questionnaire. A significant inverse association between the risk of diabetes and total dietary fiber was determined through the study. There was

also a strong association with cereal fiber and decreased risk of type 2 diabetes mellitus after correlating different sources of fiber. Cereal fiber tended to be the strongest association, and it is unclear why this fiber has such a strong inverse association with type 2 diabetes. This study also found that fruit fiber, primarily a soluble fiber, was associated with a decreased risk of developing type 2 diabetes after adjustments were made for other sources of dietary fiber. Another study by Schulze, et al. (2007) examined soluble, insoluble, and total fiber as well as specific sources of fiber such as in vegetables, fruits, and cereals to the risk of developing type 2 diabetes. This research was prospective and a meta-analysis conducted in collaboration with the European Prospective Investigation into Cancer and Nutrition (EPIC) Postdam study in Germany. A total of 21,548 subjects, both men and women between 40-65 years of age, completed a food frequency questionnaire, personal interview, and anthropometric measurements. Follow-up questionnaires were given after the data collection time period. It was found that soluble fiber was inversely associated with risk for developing type 2 diabetes; however, after adjustments for insoluble fiber and for dietary confounders there was no association of insoluble fiber with risk for type 2 diabetes mellitus. In this study, cereal fiber was also found to be inversely associated with developing type 2 diabetes independent of factors such as age, sex, and lifestyle risk factors. Cereal fiber was strongly correlated with intake of insoluble and soluble fiber. Cereal fiber was also moderately associated with fruit and vegetable fiber consumption. Wholegrain bread and muesli were also correlated with the cereal fiber intake. Therefore, whole-grain bread intake was associated with decreased risk for developing type 2 diabetes. Fruit and vegetable fiber were found to not be associated with reduced risk for diabetes mellitus. This study concluded that whole grain foods are important in preventing type 2 diabetes as well as cereal fiber. According to Hu, Van Dam and Liu (2001), whole grain products produce

slower glycemic and insulin responses than refined grains. Another study by Bo et al. (2006) reported an association with developing type 2 diabetes and lower fiber intake from a population-based cohort of 1653 adults with normal BMI. There was also a strong positive correlation with magnesium and fiber intake. Lastly, fiber intake showed an inverse association with C reactive protein plasma levels (CRP). CRP is a predictor of diabetes.

Previous research discussed is in disagreement as to what type of dietary fiber contributes to a reduced risk of type 2 diabetes mellitus. However, studies support the conclusion that high fiber intakes contribute to preventing type 2 diabetes mellitus. Therefore, total dietary fiber was examined in the current study.

Magnesium and Risk for Type 2 Diabetes Mellitus

Magnesium intake has been examined in relation to developing type 2 diabetes mellitus in recent years. Recently in a prospective and meta-analysis study Shulze et al. (2007) examined both fiber and magnesium intake in German men and women 35 to 65 years of age and reported a significant inverse association between the risk of developing type 2 diabetes and magnesium intake. The study concluded that whole grain foods that are rich in fiber and magnesium are important in the prevention of diabetes.

A study of black women by Van Dam, Hu, Rosenberg, Krishnan, and Palmer (2006) examined magnesium in relation to type 2 diabetes and concluded that a diet high in magnesium-rich foods especially whole grains was associated with a substantially lower risk for developing type 2 diabetes. The study was an eight year prospective cohort with 59,000 women 21-69 years old. Statistical analysis was performed using the Cox proportional hazards regression model. The results showed trends such as older, leaner, more physically active, nonsmoking and highly educated women tended to have a higher magnesium intake. High magnesium intake was

associated with a higher fiber, whole grain, dairy, and coffee intake. Lower intakes of alcohol, saturated fat, red meat, sugar-sweetened soft drinks and linoleic acid were also associated with high magnesium intake. In explaining the possible relationship with magnesium and type 2 diabetes, Van Dam et al. (2006) stated:

> Effects of poor magnesium status on glucose homeostasis are plausible and may be mediated through oxidative stress, the role of magnesium as cofactor for enzymes involved in glucose metabolism, or the effects of intracellular ion levels on insulin sensitivity and insulin secretion. (p. 2242)

Some major food sources of magnesium are: vegetables, whole grain bread, cold cereals, and milk. An examination of risk for developing type 2 diabetes in women by Song, Manson, Buring, and Liu (2004) concluded that a high magnesium intake protects against the development of the disease in overweight subjects. This study was randomized, double-blind, and a placebo-controlled investigation. There were 39,876 female health professionals 45 years or older with no history of cancer, type 2 diabetes or cardiovascular disease. Cox proportional hazard models were used to estimate relative risk for type 2 diabetes with magnesium intake. A significant inverse relationship with magnesium intake and the risk of type 2 diabetes was reported. Median magnesium intake was 326 mg/day which was close to the recommended daily allowance of 320 mg/day for adult women. A lower BMI was associated with higher magnesium intake as well. Magnesium intake has also been examined in relationship with the risk of metabolic syndrome by He et al. (2006). Americans age 18-30 years old were examined who were free of metabolic syndrome by the National Cholesterol Education Program/ATP III definition. A food frequency questionnaire was administered through an interviewer. The Cox proportional hazards model was used to estimate hazard ratios. The risk for developing metabolic

syndrome was associated inversely with magnesium intake in a dose dependent manner among young adults. Therefore, recent studies have shown magnesium to be inversely associated with the development of type 2 diabetes and the progression of metabolic syndrome.

Summary

After examining many articles the risk factors for developing type 2 diabetes mellitus that will be utilized in this study are: age (45 years of age or older), ethnicity (subject of Asian descent), low physical activity, cigarette smoking, and BMI values at overweight or obesity levels. Magnesium and fiber intakes will be considered risk factors if inadequate amounts are reported via a quantitative food frequency questionnaire.

Chapter III: Methods

The purpose of this study was to analyze if the Dunn County Hmong population has a risk for developing type 2 diabetes mellitus. This chapter describes all procedures used to conduct the research. It describes how subjects were selected and the instrument used in the study. Secondly, the chapter describes the statistics used to analyze the data. Lastly, limitations of the instrument and data collection procedures are discussed. All methods described were approved by the University of Wisconsin-Stout (UW-Stout) Institutional Review Board for Protection of Human Subjects (IRB) prior to initiating the study.

Subject Selection and Description

The subjects of this study were selected from the Hmong population of Dunn County, Wisconsin. Subjects had to be age 18 years or older to participate. However, gender was not restricted. These subjects were selected from participants in the Dunn County Special Supplemental Nutrition Program for Women, Infants, and Children (WIC) and Hmong students enrolled at UW-Stout and involved in the Hmong Stout Student Organization (HSSO) during the Spring 2007 semester.

WIC participants were selected for sampling because the program was a feasible way to access the Hmong population of Dunn County due to the researcher's limited accessibility with subjects of the population. The researcher met with the director of the WIC program and discussed the purpose of the study and gained approval for collecting data. The director decided that the WIC program would not benefit from the results of the study; therefore, no obligation to report research data to the WIC program was made. The director described that the Dunn County WIC office, the only office of its kind in the county, had a Hmong population of approximately

75 participants, which represented about 10% of the total population. The director gave the researcher dates and times in which Hmong clients were scheduled with WIC over a period of three months. Data was collected over a three month period because it is the cycle in which each WIC participant was scheduled for an appointment. This procedure thereby ensured that all WIC participants were asked to participate in the study. A written informed consent statement (Appendix A) was presented and read by all possible subjects which described: the purpose of the study, the age requirement, the risks and benefits involved, contact information for any questions, the time commitment involved, the right to withdraw, confidentiality involved and IRB approval for the study. All subjects who signed an informed consent to participate were selected for the study. As an expression of appreciation, all participants were given a juice box for participating.

The HSSO population was utilized due to only eleven participants from the WIC agreed to participate in the study. The president of the HSSO was contacted via email to ask permission to conduct the study at their weekly meeting. The researcher sent the president the consent form describing the study and the instrument for collecting the data. The president asked permission at a weekly meeting if the researcher could conduct a thesis study and clarified that it was voluntary. The researcher agreed to attend a HSSO meeting when the thesis was completed to present the conclusions of the study to the group. Once permission was granted, the researcher attended the HSSO meeting where 25 members were present and 20 agreed to participate in the study. The researcher explained the purpose of the study to the group, asked if anybody had questions about the study and encouraged HSSO participants to read the consent form. All students who signed an informed consent were selected to participate in the study. All participants were given a box of juice as a symbol of appreciation.

Instrumentation

The instrument used in data collection of this research consisted of a 13 item survey and a 121 item quantitative food frequency questionnaire (Appendix B). This instrument was designed by the researcher to be utilized in this study only. This instrument was not pilot tested due to limited access to potential participants which would have taken away subjects from the actual number of participants. The instrument was created to determine the risk for developing type 2 diabetes mellitus by measuring dietary patterns and lifestyle factors.

The 13 item survey included questions designed to obtain demographic information, country of birth, length of time in U.S., physical activity, barriers to physical activity habits, diagnosis of diabetes, medical history, height, body weight, frequency of eating out, and snacking habits. Of these questions, physical activity, length of time in U.S., diagnosis of diabetes, cigarette smoking, and medical history were utilized to analyze risk for type 2 diabetes mellitus. Body mass index (BMI), determined from height and weight measurements, was also used to analyze risk for developing type 2 diabetes. The remaining assessments (i.e., barriers to physical activity, frequency of eating out, and snacking habits) were used to further describe lifestyle factors (diet and physical activity) that may be associated with developing type 2 diabetes.

The 121-item quantitative food frequency questionnaire contained food choices typical of both American and Hmong American diets. Ikeda (1992) created a food list of a supplementary exchange list for Hmong American foods published by the American Dietetic Association. The Hmong-American food items placed on the questionnaire was from this list (Appendix C). Other foods added were typical of the American diet.

The questionnaire was designed to clump food items into food groups. Groups included were: vegetables, fruits, grains, dairy, meats, condiments, drinks, and miscellaneous foods (various other foods). The questionnaire asked how many times a day, week or month the subjects ate each food item as well as the number of portions (amounts) consumed. Portion size options varied on the questionnaire depending on the food group. For instance, the vegetable group gave subjects the choice to select from a tablespoon, ½ cup, 1 cup, and a plate, which was described to the participant as 3 cups.

To tabulate food frequency data for statistical analysis, responses for each participant required conversion to a standard measurement such as the number of times an individual food could have been reported per day, week or month. Raw data reported for the use of food items were standardized to a month. The monthly frequency was determined by multiplying a daily response by 29 days (considered to be equivalent to one month in this study), and a weekly response by four weeks. Similarly, the number of portions subjects reported for each food item was converted to a standard measurement for each food group. For instance, the number of portions subjects reported for the meat group was converted to ounces per day; whereas portions for the vegetable group were converted to cups per day. The daily quantity of each food group was determined by adding the frequencies of each food item consumed per month within the group, and then dividing the total by 29 days. For example, the number of times a Mango was eaten per month was totaled for all participants and all other fruit items were added in the same manner. The total of each fruit item was added and divided by 29 days to determine the total fruit servings per day eaten. Data for food groups were statistically analyzed according to the frequency each group was eaten per day (number of times eaten per day), the daily amount consumed from each food group, as well as the quantity of magnesium and fiber eaten per day.

Data for individual food items were analyzed according to frequency eaten, amount consumed, magnesium, and fiber intake per month.

The 121 food items were entered into the United States Department of Agriculture, National Nutrient Database for Standard Reference, Release 21 (2008) to determine the fiber and magnesium levels of each item per cup or ounce depending on the food group. These levels were multiplied according to the number of one-cup or one-ounce portions subjects consumed to get a total magnesium and fiber level. For instance if a subject reported 2 cups of broccoli as the number of portions consumed and reported eating it 2 times a month, then the subject ate a total of 4 cups of broccoli per month. Therefore, 4 times the magnesium or fiber content in one cup of broccoli would equal the total amount of magnesium or fiber from broccoli in one month. Monthly values were divided by 29 days to determine the total intake of magnesium in milligrams per day, and the total intake of fiber in grams per day. Daily magnesium intake was compared to Recommended Dietary Allowances (RDA) and the total fiber intake was compared to the Adequate Intake (AI). The RDA for magnesium for adult males is 420 mg/day and for women is 320 mg/day according to Shils, Shike, Caballero, & Cousins (2006). The AI for fiber is 25 gm/day for women from the age of 19 to 50 and 38 gm/day for men from the age of 14-50.

Height and weight were also measured after the survey and questionnaire were completed to calculate the subject's BMI. Body weight for WIC participants was measured using a calibrated Tanita digital scale model WB-300MH. Measurements were taken in private at the WIC laboratory with doors shut and blinds closed. The subject was asked to take off their shoes and hat to obtain height and weight. Height was measured by having the participant face the researcher with the back of their head facing the wall; the subject's head was adjusted to the Frankfurt plane by the researcher and the measurement was recorded. The subject did not move

and the researcher read the number on the digital scale for weight. For Hmong college subjects, body weight was measured using a DETECTO physician's scale model number 338 that was obtained from the University of Wisconsin- Stout Nutrition Assessment Laboratory and was calibrated on site at the HSSO meeting. The scale was placed between three concrete walls in the corner of the room to minimize visibility to other participants so that only the researcher and subject could visualize measurements. Weight was measured by having each participant take their shoes off; however, street clothes were worn and the subject was positioned so that the back of his/her head was toward the wall. Weight was measured to the nearest pound by sliding the heaviest weight to the appropriate amount and then the smallest was slowly pushed across the scale until the scale lever was level. Height was measured using a portable stadiometer on each of the scales used to measure weight. Lee and Nieman (2003) demonstrated the Frankfort horizontal plane technique which was used to measure height. This technique is performed by measuring with a ruler from the lower part on the margin of the orbit of the eye to the tragion of the ear in which the ruler is horizontal and parallel to the ground. According to Lee and Nieman, this technique ensures a consistent measurement for height on all subjects. Also, all hats were removed and height was recorded to the nearest 0.1 inch.

BMI (kilograms per meter squared) was then calculated by converting inches to meters and then squaring it and pounds were converted to kilograms. Kilograms were then divided by meters squared. The number resulting was BMI. The classification of BMI from the Department of Health and Human Services, National Institutes of Health and National Heart, Lung and Blood Institute (n.d.) was used to determine body weight status of adults 20 years and older as follows: <18.5 underweight, 18.5-24.9 normal, 25-29.9 overweight, 30-34.9 obese I, 35-39.9 obese II, and ≥ 40 obese III. For subjects under the age of 20, overweight status is determined by plotting BMI

and age on a BMI-for-age growth chart for boys and girls. The BMI-for-age growth charts classify overweight as greater than or equal to the 95th percentile. Therefore, measurements of height and weight with the BMI calculation were used to classify overweight/obesity as a risk factor for developing type 2 diabetes mellitus in this study.

An interpreter for this research was vital to enable the researcher to collect data on all participants of WIC. The interpreter was trained by reviewing the informed consent, survey tool, interpreter script, and food frequency questionnaire.

Data Collection

Data was collected for this study February, 2007 through May, 2007. Thirty-one Hmong Dunn County residents participated in the study.

For WIC participants, the researcher collected data on 20 days during a three-month period by visiting the WIC clinic to obtain subjects who were scheduled for an appointment on that day. Data was collected from February through May since the WIC scheduling runs on a three-month reevaluation appointment cycle. Upon arrival to the clinic, the client was asked to participate in the UW-Stout thesis project with the use of the script created to avoid variation between subjects (Appendix D). Participants were not to give their name or any other identifiable personal information. After reading and signing the consent form, the instrument was administered by handing it to the subject and asking for him/her to read and complete it. Participants were informed of the food models displayed on a nearby table to show standard portion sizes to typical foods. Therefore, the food models were used as a reference for completing the quantitative food frequency questionnaire. Each participant was encouraged to look at the food models and use them to estimate the quantity of each food item consumed. Subjects were told a "plate of food" was equivalent to three cups. After finishing the survey and

questionnaire, subjects were asked to have their height and weight measurements recorded for the survey. The completed instruments were placed into a locked file. The total data collection took 25-30 minutes to complete per person.

The researcher also collected data on subjects from the Hmong Stout Student Organization in a manner as previously described of WIC subjects. The length of time however was different. Data was collected in May at one weekly meeting at UW-Stout.

In instances where the subject did not speak English, an interpreter was hired and followed the script. The interpreter followed the script beginning with an introduction of the interpreter to subject, asking for participation, reading the consent form and then asking if subject was willing to participate in study. The subject then signed the consent form and then was given the instrument through translation by the interpreter. Their responses were completed by the interpreter as each question was asked. The researcher was also present and for each question, showed an example of the portion size for each food group, and the subject pointed to the amount for the interpreter. After the interpreter completed the survey and questionnaire, the interpreter asked the subject to follow the researcher to have height and weight taken. The researcher took the measurements of the subject, and the interpreter concluded with thanking the subject for participating. The role of the professional interpreter was small due to only one participant needing an interpreter.

Data Analysis

Descriptive statistics were used to determine frequencies of food groups and items in the food frequency questionnaire The program used for analyzing this data was the Statistical Program for Social Sciences (SPSS), version 14.0. The United States Department of Agriculture, Center for Nutrition Policy and Promotion (2005) MyPyramid recommendations, assuming a

2000 calorie diet, were used a as standard for comparing to the average daily food intakes from the grain, vegetable, fruit, meat and bean, and milk groups in this study. These are the five major MyPyramid food groups, which are comparable to food groups used in this study. For these comparisons, changes were made to classify food items according to the MyPyramid groups and to eliminate duplication of food items that appeared in the food frequency questionnaire. Therefore, bitter melon was placed into the vegetable category. Eggs were placed in the meat category. To avoid duplication, cucumber listed as item number 23, and the Chinese parsley listed as item number 26 were not analyzed (see Appendix B to view original survey).

An independent sample t test was used to compare fiber and magnesium levels, and BMI, smoking, age, length of time in the U.S. and physical activity categories with each other separately. Physical activity levels were also compared to the recommended standards presented in the Wisconsin Nutrition and Physical Activity Program (2005) as 30 minutes/day of physical activity for 5 days a week. The mean was calculated for age, smoking, family medical history of diabetes, hypercholesterolemia, hypertension and self-report of diabetes.

The risk factors for type 2 diabetes were based on very specific criteria in this study. The subject was considered at risk at 45 years old or older. The overweight status for males and females 18 to 20 years old needed to be at or above the 95^{th} percentile in the gender-specific BMI-for-age growth charts. A BMI of 25 or more for those 20 years or older was considered a risk due to overweight/obesity. Physical activity was considered a risk if subjects did not meet 30 minutes five times per week or 150 minutes per week. If subjects reported having high blood pressure, high cholesterol or diabetes they were considered at risk. Magnesium intake of less than or equal to 280 mg/day for males and 213.3 mg/day for females (2/3 or less of the RDA for adult gender groups) was considered at risk. Lastly, fiber intake of less than 16.67 grams/day

(2/3 or less of the 25 gram AI for adult women) was considered at risk, in accordance with Shils, Shike, Ross, Caballero, and Cousins (2006). All risk factors were examined with a Pearson correlation coefficient matrix. With an interest in length of time living in the U.S., an analysis of variance (ANOVA) test was performed. The ANOVA examined the differences between and within group means for the risk factors of magnesium and fiber intakes using length of time living in the U.S. as the independent variable.

Limitations

Due to selection of a convenient sample based on the availability of participants, the sample may not have correctly represented the population distribution of Hmong in Dunn County, Wisconsin. Another limitation to the method was the language barrier. The interpreter may not have fully understood the study or the contents creating a different interpretation of the question, resulting in a different type of answer. Due to inability to collect all of the data at one location, the use of two different calibrated scales may have been a limitation to the study because not all subjects were measured on the same scale which may create a variance in weights measured. Subjects may have over or under estimated the amount of exercise or food eaten therefore creating a limitation to the study. The instrument clustered questions instead of individually assessing each participant. This approach generalized the data making it less accurate. The fact that the survey and food frequency questionnaire given by the researcher was not validated could have affected the results. Lastly, fiber intake was calculated with only using 25 g/day which is the AI for women and not men. This calculation overestimated the amount of subjects who had an adequate intake of fiber.

Chapter IV: Results

The purpose of this study was to identify if Hmong living in Dunn County, Wisconsin have a risk for developing type 2 diabetes mellitus by identifying the prevalence of several risk factors that may be associated with developing this disease, by use of a survey and a quantitative food frequency questionnaire. There were 31 surveys and questionnaires administered and all were included in the analysis. The risk factors examined were: age, overweight or obesity, frequency of use of food groups, daily intakes of magnesium and fiber, physical activity level, cigarette smoking habits, and past medical history of type 2 diabetes, blood cholesterol and blood pressure.

Demographics

Thirty-one subjects participated in the study. The majority (54.8%) were male (n=17) and 45.2% were female (n=14). Characteristics of the age and gender distribution of subjects are described in Figure 1. The age of subjects varied from 18 years to 60 years. The subjects who were 18-20 years comprised 48.4% (n=15) of the sample. This age group included 53% male and 43% female. Those who were 21-25 years old consisted of 35.5 % (n=11) of the sample. Subjects who were 26-30 years old were 6.5% of the sample (n=2) one a male and one a female. There was one male subject in the category of 41-45 years old representing 3.2% of the total sample. Lastly, the subjects 51 years or older represented 6.5% of the sample (n=2). All subjects in this age group were males.

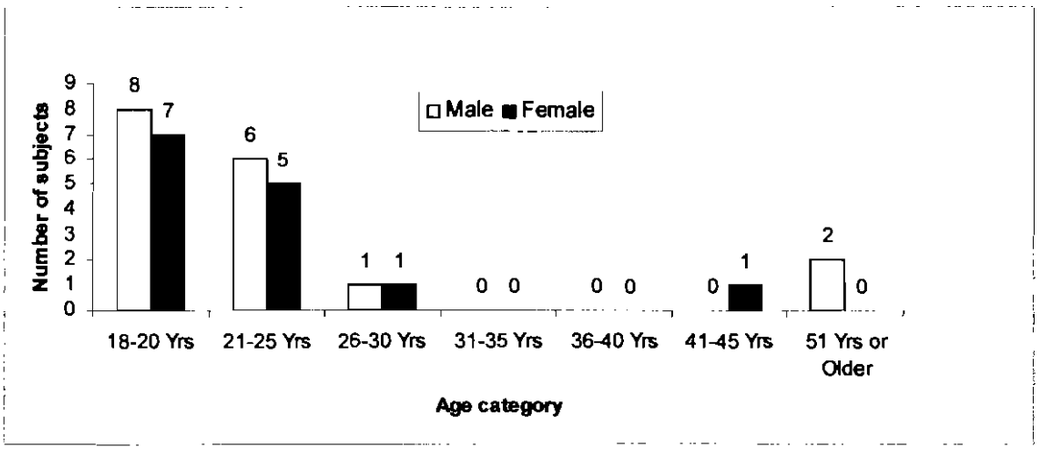

Figure 1. Gender and age distribution of respondents (n=31).

Respondents who were born in the U.S. consisted of 25.8% (n=8) of the sample in which 37.5% (n=3) of them were male and 62.5% (n=5) were female. Of the subjects born in the U.S. 62.5% (n=5) were 18-20 years old and 37.5% (n=3) were 21-25 years old.

Subjects who were not born in the U.S. represented 74.2% (n=23) of the sample. Of these subjects 60.9% (n=14) were male and 26.1% (n=6) were females. Only 4.3% (n=1) of them lived in the U.S. for less than 1 year to 4 years; no subjects lived in the U.S. for 5-9 years; 26.1% (n=6) lived in the U.S. for 10-14 years; 39.1% (n=9) lived in the U.S. for 15-19 years, and 30.4% (n=7) of those not born in the U.S. had lived here 20 years or longer. None of the subjects either born or not born in the U.S. lived here 5-9 years.

Snacking Pattern

The snacking habits of respondents are presented in Figure 2. Of the 31 subjects, 58.1% (n=18) responded that they snack and 41.9% (n=13) responded that they do not snack. Of those who snack, most subjects 38.8% (n=7) snack twice a day; 27.7% (n=5) snacked three times a day which was the second most frequent consumption reported from snacks. Only 5.5% (n=1) subjects ate snacks five times per day.

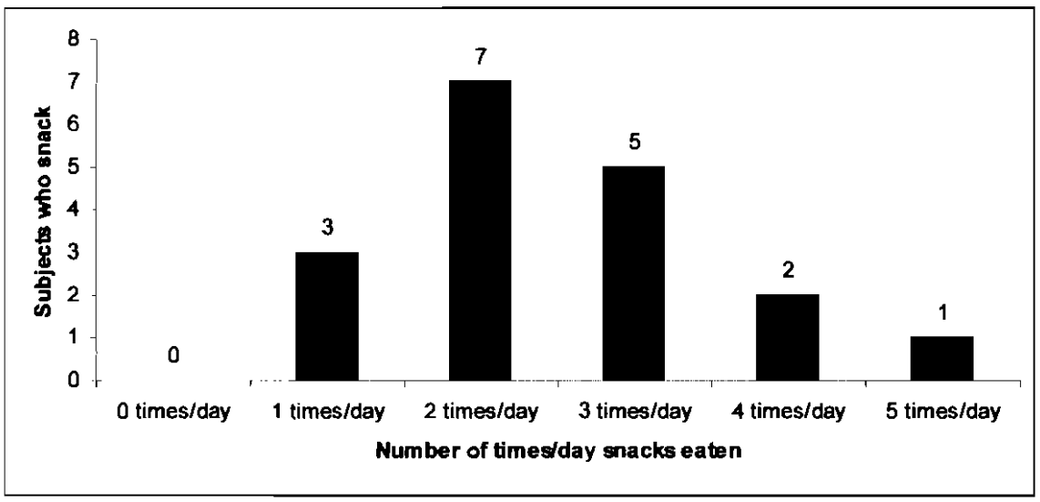

Figure 2: Mean frequency of snacks eaten per day by subjects (n=18).

Eating Out

Subjects were also asked how many times a week they went to a restaurant or a quick place to eat. Results show that the majority or 75% (n=24) of the subjects ate out at least once per week, whereas 25.8% (n=8) did not go to a restaurant or a quick place to eat. Among those who eat out, 35.5% (n=11) reported eating out one time a week; 22.6% (n=7) of the subjects ate out two times per week; whereas 9.7% (n=3) ate out three times per week. Lastly, 6.5% (n=2) of the subjects ate out five times a week or more.

When grouped according to how long subjects have lived in U.S., 68.8% (n=11) of those who lived here for 15 years or longer ate out 2 times per week. However, of the seven subjects who lived here less than 14 years, 85.7% (n=6) ate out one time per week. Of the eight subjects born here, 62.5% (n=5) ate out 1 time per week.

Food Group Consumption

Table 1 presents the average portion size consumed per day from each food group studied: vegetables, fruits, grains, dairy, meat, drinks, condiments, and miscellaneous foods. Findings show that subjects consumed the largest amount from the drink group followed by the

meat group and then the grain group. Drinks may have been over reported because data show 43.23 cups were consumed on average per day which may be physically impossible. Vegetables and fruit were consumed to a lesser extent and both exceeded 1½ cups a day. Consumption from the dairy group and miscellaneous foods were both less than 1 cup a day. The group used the least was the condiment group.

Table 1

Average Portions (Amounts) from Food Groups Consumed per Day Compared to Recommended Amounts per Day

Food Group	Average amounts consumed per day	MyPyramid Recommended amount per day
Vegetables	2.39 cups	2.5 cups
Fruit	1.59 cups	2 cups
Grains	4.51 cups (9.02 ounces rice)*	6 ounces
Dairy	0.78 cups*	3 cups
Meat	20.78 ounces*	5.5 ounces
Drinks	43.23 cups	Not applicable
Condiments	0.79 tablespoons	Not applicable
Miscellaneous foods	0.93 cups	Not applicable

Note: *$p<.05$, one sample t test

When daily intakes were compared with MyPyramid recommendations for the five major food groups via a t test, data indicate that subjects consumed significantly higher amount of grains and meats than recommended, and significantly less than the recommended amount of milk/dairy. Average intakes from the grain group was 4.51 cups (a 9.02 ounce equivalent of white rice) compared to the 6 oz per day recommendation for grains. Consumption from the meat

group might have been over reported because the average daily intake of meat is high at 20.78 oz. Three cups of dairy per day is recommended; however, the subjects of this study consumed only consuming 0.78 cups per day. Although differences for the remaining MyPyramid groups were not significant, intakes fail to meet the daily recommended amounts. The subjects of this study had an average intake of 2.39 cups of vegetables per day, compared to the 2.5 cups recommended. The average intake from the fruit group was 1.59 cups, compared to the 2 cup recommendation of fruit.

Consumption from the Vegetable Group

The vegetable food group contained 29 vegetable choices. Figure 3 shows the frequency subjects reported consuming each item per month. Cilantro/parsley, chili peppers, and leafy green vegetables were consumed the most during a month. Beets, kohlrabi, zucchini and baby corn were consumed least often.

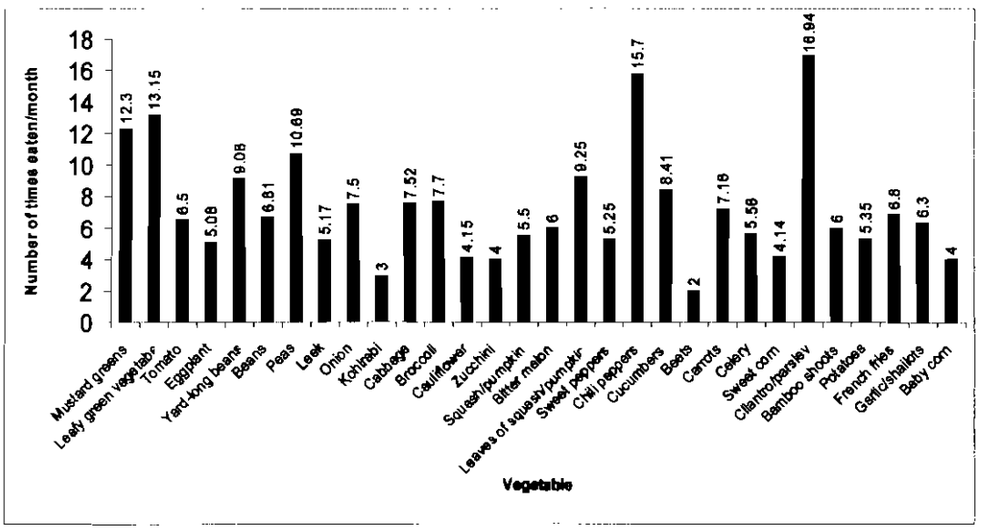

Figure 3. Mean frequency of vegetables eaten per month.

Listed in Table 2 are the top 10 vegetables eaten most often by the sample along with the ten vegetables eaten in the largest amount per month, and the ten vegetables contributing the highest amounts of magnesium and fiber in the diet. The vegetables eaten in the largest portions per month were leafy green vegetables (11.6 cups), French fries (9.7 cups), and leaves of pumpkin or squash (8.94 cups) while cucumbers ranked last among the ten vegetables used in the largest amounts. Vegetables that provided the most magnesium were French fries (349.20 mg), peas (269.77 mg) and yard-long beans (266.75 mg). Kohlrabi ranked tenth among the ten leading sources of magnesium. The vegetables providing the subjects with the highest fiber content were French fries (45.59 g), yard-long beans (39.40 g) and peas (28.9 g), similar to magnesium. However, tomatoes supplied the least fiber among the ten leading sources in diets of these subjects. As further illustrated in Table 2, while cilantro/parsley was consumed most often, it also accounted for one of the ten vegetables consumed in the largest portion sizes. However, cilantro/parsley was not a leading source of magnesium or fiber in the diets of these subjects. Mustard greens, peas, leaves from pumpkins, squash and yard-long beans were the only vegetables that ranked among the top ten in each category: number of times eaten, portion size, magnesium content and fiber contents. Interestingly, although French fries and tomatoes were not among the most frequently consumed vegetables, both were among the leading ten vegetables used in the largest amounts and contributing the highest amounts of magnesium and fiber.

Table 2

Top 10 Vegetables Consumed by Mean Frequency, Amount, Magnesium and Fiber Content per Month

Food item	Number of times eaten	Amount Consumed (cup)	Magnesium content (mg)	Fiber content (g)
Cilantro/parsley	16.94	6.21		
Chili peppers	15.70			
Leafy green vegetables	13.50	11.6		
Mustard greens	12.30	7.68	161.30	21.50
Peas (sugar, snow sweet)	10.69	6.42	269.77	28.9
Leaves pumpkin/squash	9.25	8.94	241.30	16.98
Yard-long beans	9.08	6.16	266.75	39.40
Cucumbers	8.41	5.15		
Broccoli	7.70			28.44
Cabbage (green/red)	7.52	5.96		
French Fries		9.70	349.20	45.59
Tomato		8.65	190.25	14.70
Squash/pumpkin			218.58	
Sweet corn			141.38	
Zucchini			138.20	
Kohlrabi			113.67	
Bitter melon				26.80
Beans (green/yellow)				17.74
Carrots				16.46

Consumption from the Fruit Group

Figure 4 presents the frequency of the 16 fruits consumed by subjects in the study. The most common fruits consumed were fruit juice (23.3 times), bananas (11.72 times), and apples (8.81 times) per month on average. The fruits eaten least often were jackfruit (1.8 times), papaya (2.17 times), and guava (2.75 times) per month.

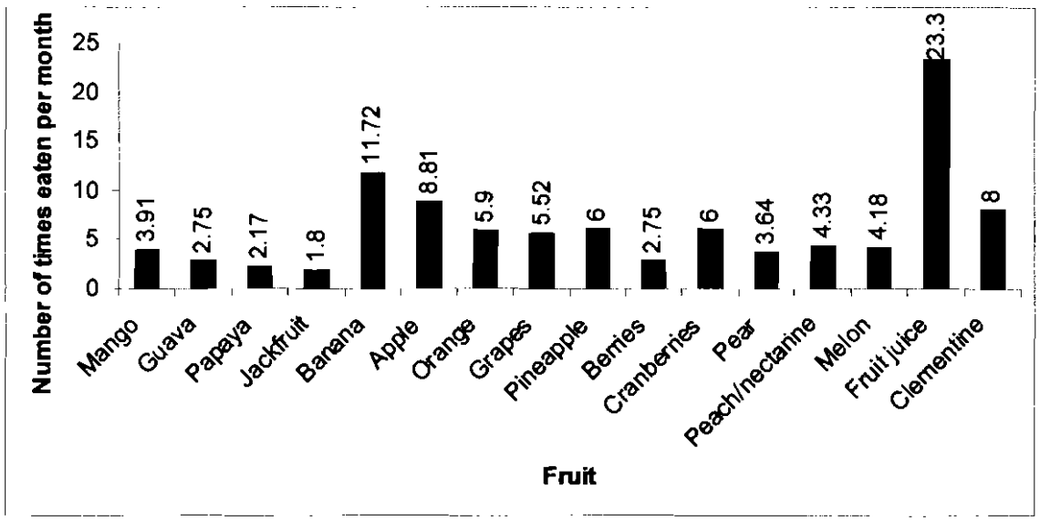

Figure 4. Mean frequency of fruit eaten per month.

Table 3 shows the top 10 fruits consumed most often, consumed in the largest amount, and provided the highest amounts of magnesium and fiber. The fruit consumed in the largest amounts per month were fruit juice (23.88 cups), bananas (10.34 cups), and clementines (8 cups). Fruits that supplied the highest magnesium content were bananas (413.6 mg), clementines (184 mg), and fruit juice (167.17 mg). Fruits that provided the highest fiber content were bananas (40.32 g), oranges (21.53 g), and apples (18.83 g). It is important to note that cranberries and clementines were only reported by one subject each.

Table 3 further illustrates bananas were the second most frequently used fruit; they were also the leading source of magnesium and fiber from fruits. However, the fruit consumed most

often was fruit juice which does not provide any fiber to the diet. Common fruits eaten the most often, in the larger amounts, as well as top sources of magnesium and fiber in the diet were: bananas, apples, oranges and peaches/nectarines. Interestingly, although jackfruit, mangoes, pineapples and pears were not among the 10 most frequently eaten fruits, they were among the top ten sources of magnesium or fiber in the diet.

Table 3

Top 10 Fruits Consumed by Mean Frequency, Amount, Magnesium and Fiber Content per Month

Food item	Number of times eaten	Amount consumed (cup)	Magnesium content (mg)	Fiber content (g)
Fruit juice	23.30	23.88	167.17	
Banana	11.72	10.34	413.6	40.32
Apple	8.81	7.24	89.88	18.83
Clementine	8	8	184	10.4
Pineapple	6	4.75		10.41
Cranberries	6	3		13.2
Orange	5.9	5.98	107.63	21.53
Grapes	5.52	3.96	43.61	
Peach/nectarines	4.3	3.7	51.86	8.52
Melon (cantaloupe/honeydew)	4.18	2.34	49.16	
Jackfruit			64.05	
Guava			50.06	12.38
Pear				11.2
Mango				6.95

Consumption from the Grain Group

The findings show that white rice, ramen noodles, and brown rice were grains eaten most often, 38.17, 12.55, and 12 times per month, respectively, (Figure 5). Enriched spaghetti, other pasta noodles and rice soup were eaten the least often, 2.4, 3.83, and 4.29 times per month, respectively.

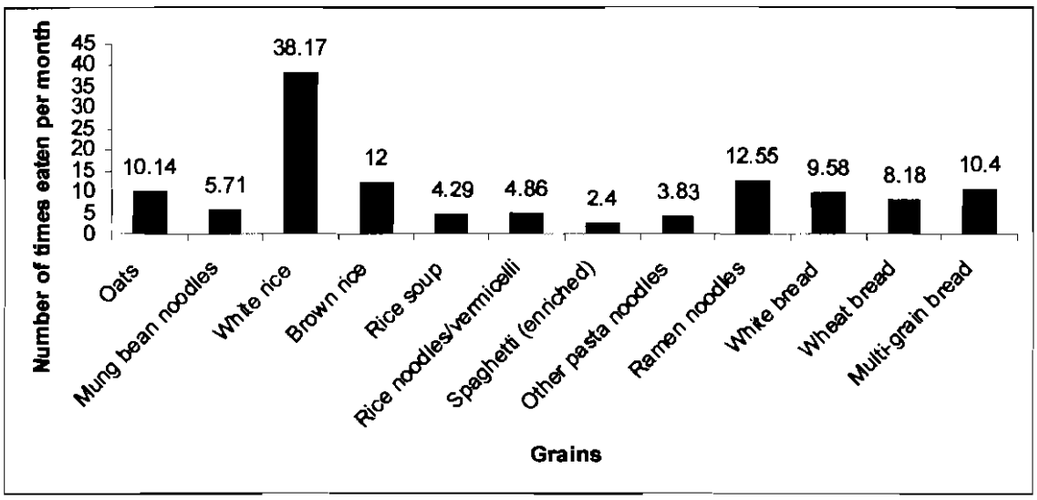

Figure 5. Mean frequency of grains eaten per month.

Refer to Table 4 for the top ten grains subjects consumed according to frequency, the largest amount, highest magnesium content, and highest fiber content. The largest portions of grains eaten per month were white rice (83.81 cups), ramen noodles (24.28 cups), and white bread (23.42 slices). Whereas, enriched spaghetti (2.4 cups) and other pasta noodles (3.83 cups) were consumed the least often.

Oats, multi-grain bread, and brown rice, representing 4258.29 mg, 3343.41 mg, and 2688 mg respectively, provided the most magnesium per month for grains (Table 4). The highest fiber sources from grains were oats, multi-grain bread, and brown rice representing 254.57 g, 197.06 g, and 112 g respectively. Among the 10 leading sources of grains, rice noodles supplied the least magnesium, while other pasta noodles supplied the least fiber in the diets of the subjects. Although white rice was eaten in much larger quantities it was not the primary source of magnesium or fiber in the diet. Oats provided the largest magnesium and fiber content despite being consumed only 10 times per month. Rice soup and cellophane or mung bean noodles were among the top 10 grains eaten per month; however, they did not provide magnesium or fiber to the diet.

Table 4

Top 10 Grains Consumed by Mean Frequency, Amount, Magnesium and Fiber Content per Month

Food item	Number of times eaten	Amount consumed (cups)	Magnesium content (mg)	Fiber content (g)
White rice	38.17	83.81	1592.4	50.29
Ramen noodles	12.55	24.28	461.28	48.56
Brown rice	12	32	2688	112
Multi-grain bread	10.4	21.20 (slices)	3343.41	197.06
Oats	10.14	15.43	4258.29	254.57
White bread	9.58	23.42 (slices)	140.5	18.73
Wheat bread	8.18	16.9 (slices)	202.91	32.13
Cellophane or mung bean noodles	5.71			
Rice noodles or vermicelli	4.86	8.09	40.45	14.56
Rice soup	4.29			
Spaghetti (enriched)		6.30	157.5	15.75
Other pasta noodles		5.84	58.39	10.51

Consumption from the Dairy Group

Findings show that subjects reported using all of the dairy items. Figure 6 presents the number of times per month all dairy items were eaten. Skim milk (16.8 times), chocolate milk (15.5 times) and whole milk (13.33 times) were the dairy items consumed most often. Cheese, 2% milk, and yogurt were used to a lesser extent. Sour cream (2.33 times) and sweetened condensed milk (1 time) were eaten the least.

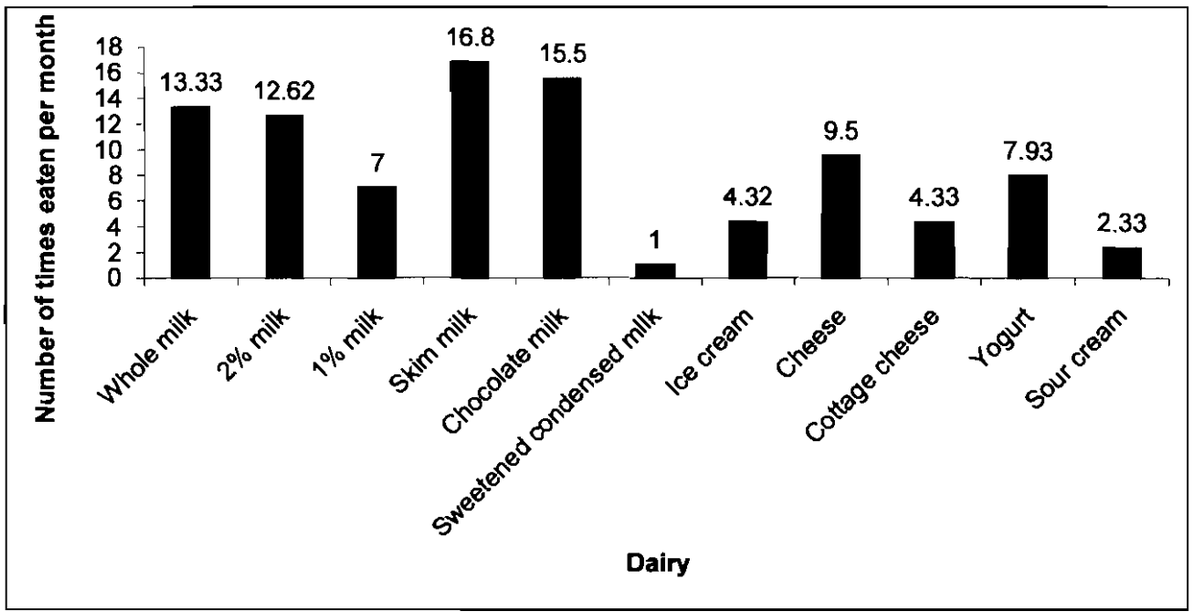

Figure 6. Mean frequency of dairy eaten per month.

Table 5 examines the top 10 dairy items eaten in the largest amount and provided the largest amount of magnesium and fiber. The dairy foods eaten in the largest quantity were 2% milk (16.3 cups), skim milk (15.55 cups) and chocolate milk (15.5 cups) per month. These same foods, chocolate milk (542.5 mg), 2% milk (440.3 mg), and skim milk (419.85 mg), provided the largest amount of magnesium in the dairy group. Only 2 items provided fiber in the dairy group, which were chocolate milk and ice cream.

When further examining Table 5, all varieties of milk, cheese, yogurt, ice cream and cottage cheese were common foods among the top ten eaten most frequently and contributing the most magnesium and fiber. However, sour cream ranked tenth among the frequency of dairy items consumed and did not provide magnesium or fiber to the diet. Condensed milk was not among the ten dairy times eaten most often; however it did provide an important source of magnesium to the diet.

Table 5

Top 10 Dairy Items Consumed by Mean Frequency, Amount, Magnesium and Fiber Content per Month

Food item	Number of times eaten	Amount consumed (cups)	Magnesium content (mg)	Fiber content (g)
Skim milk	16.8	15.55	419.85	
Chocolate milk	15.5	15.5	542.5	27
Whole milk	13.33	8.5	204	
2% milk	12.62	16.3	440.3	
Cheese	9.5	4.4	162.8	
Yogurt	7.93	7.2	230.53	
1% milk	7	6	162	
Ice cream	4.32	3.16	63.16	3.16
Cottage cheese	4.3	4.16	58.3	
Sour cream	2.33			
Condensed milk		1.25	100	

Consumption from the Meat Group

Figure 7 shows the frequency per month for 12 items subjects reported consuming from the meat group. The meat consumed most often was chicken (18.45 times), beef (18.18 times), pork/ham (10.14 times) and eggs (9.08 times); whereas, tofu/soybean curd (3.33 times), venison (1 time) and pheasant (1 time) were consumed the least often.

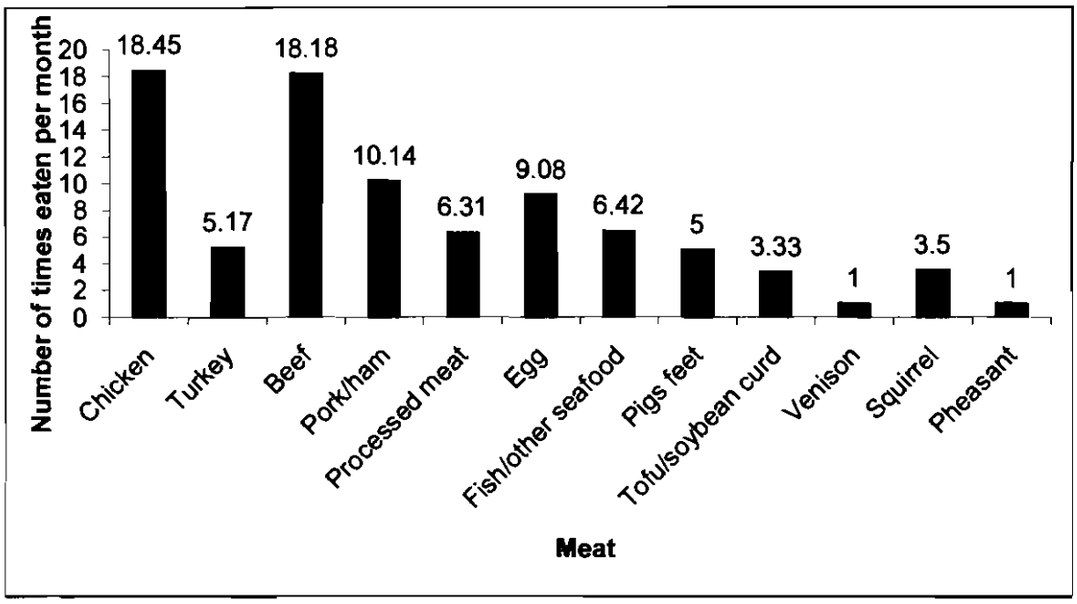

Figure 7. Mean frequency of meat eaten per month.

Table 6 examines the top 10 meat items subjects consumed according to frequency eaten, largest amount, and those that provided the most magnesium and fiber. Subjects reported eating the largest amounts of beef (225.64 oz), chicken (191.87 oz) and pork/ham (110.59 oz) per month. Beef (1353.86 mg), fish/other seafood (1321.05 mg), and chicken (959.35 mg) provided the most magnesium from the meat group. Only 2 of the meat items contained fiber, which were pork/ham and tofu or soybean curd. After further examining Table 6, all of the top 10 meats consumed were commonly eaten except for pig's feet, squirrel and tofu which were only reported by 1 subject each. All of the top ten meats consumed provided magnesium.

Table 6

Top 10 Meats Consumed by Mean Frequency, Amount, Magnesium and Fiber Content per Month

Food item	Number of times eaten	Amount consumed (oz)	Magnesium content (mg)	Fiber content (g)
Chicken	18.45	191.87	959.35	
Pork/ham	10.14	110.59	774.14	44.23
Beef	9.6	225.64	1353.86	
Eggs	9.08	17.9*	89.58	
Fish/other seafood	6.42	66.05	1321.05	
Processed meat	6.31	62.4	124.92	
Turkey	5.17	80.3	321.33	
Pig's feet	5	20	20	
Squirrel	3.5	25.5	204	
Tofu or Soybean Curd	3.33	35.2	597.8	10.55

Consumption from the Drinks Group

There were 7 items in the drinks group. Therefore, Table 7 presents a rank order of all drinks according to the frequency consumed per month, amount consumed, as well as magnesium and fiber content. The items consumed most often were water (118.10 times), tea (24.5 times) and coffee (18.4 times). Wine (3 times) and hard liquor (3.13 times) was consumed least often. The drinks consumed in the largest amount per month were water (1029.7 cups), tea (205.33 cups), and soda/pop/cola (167.45 cups). Beer, tea, and coffee were the items that

contributed the most magnesium from drinks providing 296 mg, 205 mg and 110.34 mg, respectively. No item in the drinks category contributed fiber. After further examining Table 7, the common drinks consumed were water, tea, coffee, soda/pop/cola, and beer. Although, beer was only consumed on average of 7.18 times per month, it was the drink providing the most magnesium in the diet. Water, soda/pop/cola and hard liquor did not provide magnesium to the diet. No fiber was provided by the beverage group.

Table 7

Drinks Consumed by Mean Frequency, Amount, Magnesium and Fiber Content per Month

Food item	Number of times drank	Amount consumed (cup)	Magnesium content (mg)	Fiber content (g)
Water	118.10	1029.7		
Tea	24.5	205.33	205	
Coffee	18.4	110.36	110.34	
Soda/pop/cola	16.39	167.45		
Beer	7.83	148	296	
Hard liquor	3.13	13.81		
Wine	3	8.42	25.25	

Consumption from the Condiment Group

Condiments were considered a food group in this survey. Findings for the 11 items in this group are presented in Table 8. The condiments eaten most often in a month were beef tallow (12 times), ketchup (10 times), and butter (8.55 times). Lard was not eaten during the month. Pork intestine/chitterlings and coconut cream were eaten once. The condiment eaten in the largest

amount was butter (25.55 Tbsp), followed by ketchup (20 Tbsp), and then coconut cream (18.23 Tbsp); whereas coconut milk, fish sauce, and ketchup provided the most magnesium from the condiment group, representing 127.63 mg, 147.33 mg and 60 mg, respectively. Coconut cream followed by soy sauce supplied the most fiber, the only condiments that contributed to fiber to the diets of subjects.

Table 8

Condiments Consumed by Mean Frequency, Amount, Magnesium and Fiber Content per Month

Food item	Number of times eaten	Amount consumed (Tbsp.)	Magnesium content (mg)	Fiber content (g)
Beef tallow	12	12		
Ketchup	10	20	60	
Butter	8.55	25.55		
Coconut milk	8.2	18.23	127.63	
Chicken fat	8	8		
Mayonnaise	6.33	5.81		
Soy sauce	6.23	4.28	29.97	0.43
Fish sauce	5.5	4.6	147.33	
Margarine	2			
Coconut cream	1	16.7	2	5.47
Pork intestine, chitterlings	1	1.5	1.5	

Consumption from the Miscellaneous Group

Figure 8 illustrates the 14 food items found in the miscellaneous group, and the frequency in which they were eaten. The miscellaneous food items eaten most often in a month were pudding (12 times), sweetened breakfast cereal (10.22 times) and cookies (6.75 times). Similar to cookies, donuts and pizza were consumed more than 6 times but to a lesser extent. Candy bars were rarely consumed. Cream soup or chowder was never eaten during the month.

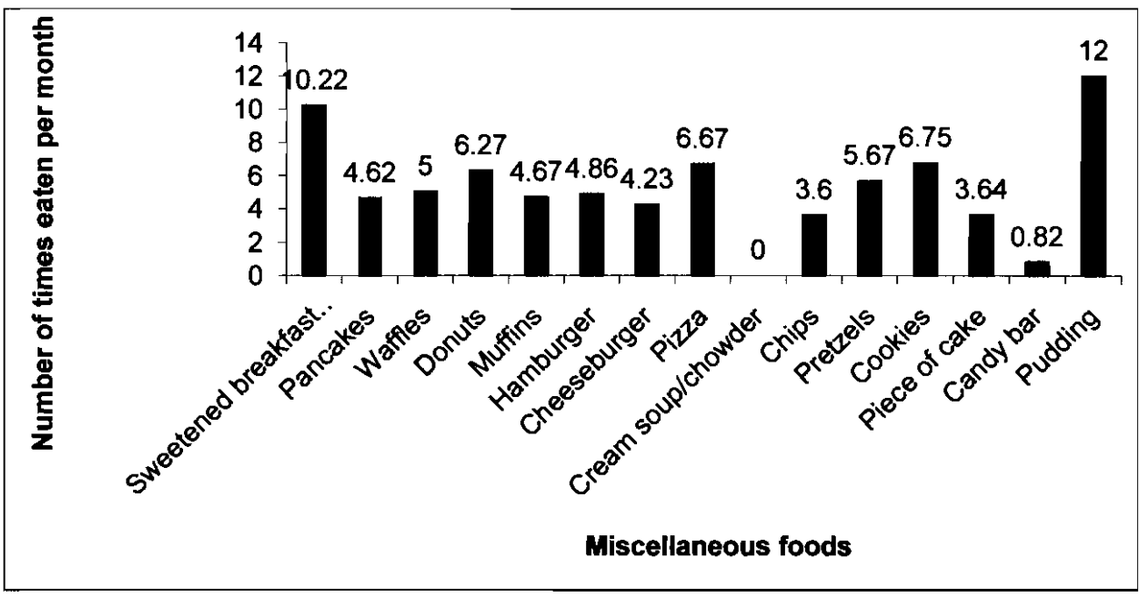

Figure 8. Mean frequency of miscellaneous foods eaten per month.

Table 9 examines the top 10 miscellaneous food items eaten, the largest amounts eaten per month, and the items supplying the highest magnesium and fiber content. The food items eaten in the largest amounts in a month were sweetened breakfast cereal (15.5 cups), pizza (7.25 each slice) and cookies (6.71 each). Potato or corn chips, pretzels, and pudding provided the most magnesium from the miscellaneous group representing 524.4 mg, 434.5 mg, and 432 mg, respectively. The foods providing the most fiber from the miscellaneous group were sweetened breakfast cereal (15.5 g), candy bar (12.82 g) and pizza (10.88 g).

After further examination of Table 9, common foods ranked in the top ten for all categories were pudding, sweetened breakfast cereal, candy bars, cookies, pizza, and donuts. However, cookies provided no fiber and donuts provided no magnesium content. Although, potato or corn chips were not consumed as frequently or in the largest amount, they provided the most magnesium content of all miscellaneous food items. Waffles were consumed frequently; however they did not provide magnesium or fiber content.

Table 9

Miscellaneous Items Consumed by Mean Frequency, Amount, Magnesium and Fiber Content per Month

Food item	Number of times eaten	Amount consumed (cup or each)	Magnesium content (mg)	Fiber content (g)
Pudding	12	6	432	5.4
Sweet breakfast cereal	10.22	15.5	279	15.5
Candy bar	7.64	6.41	217.9	12.82
Cookies	6.75	6.71	60.4	
Pizza	6.67	7.25	224.8	10.88
Donuts	6.27	3.4		3.88
Pretzels	5.67	5.5	434.50	10.45
Waffles	5			
Hamburger	4.86	4.22	113.9	5.91
Muffins	4.67	3.73		5.59
Cheeseburger		4.38	197.31	5.7
Potato or corn chips			524.4	4.49
Piece of cake			70.6	

Hmong American Foods

Ikeda et al. (1992) formulated a Hmong American food list (Appendix C) which was utilized in this study to analyze specific Hmong American foods and the magnesium and fiber intake they provided. The mean amount of magnesium per day for the Hmong American foods

was 112.93 mg and mean total fiber per day was 6.81 g. For all foods (including the Hmong American foods), the mean intake of magnesium per day was 395.95 mg and mean fiber per day was 18.84 g. Therefore, the Hmong-American foods supply 28.5% of the mean total magnesium and 36.1% of the mean total fiber per day.

Risk Factors of Type 2 Diabetes

Nine risk factors for type 2 diabetes mellitus were examined in this study: age, overweight, physical activity, diabetes, hypertension, high blood cholesterol level, smoker, magnesium, and fiber intake.

In reviewing the risk factors, no subjects reported a history of high blood cholesterol and only 3.2% of subjects reported diabetes and hypertension. Pearson correlation analyses showed no significant correlations among the risk factors studied.

The majority of subjects had a statistically significant low fiber intake (Figure 9) when independent t tests were run on each risk factor. No other risk factor presented a risk for the Hmong population in this study.

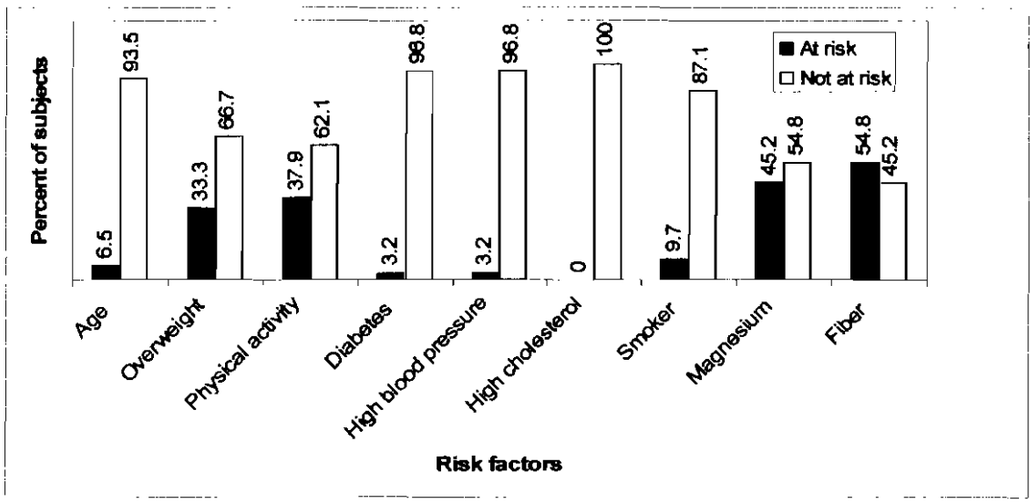

Figure 9. Risk factors of type 2 diabetes.

Magnesium and Fiber Intakes

Figure 10 shows the average daily magnesium intake from each food group as well as a total magnesium intake. Meat, grains, and vegetable groups provided the most magnesium content of all food groups. The condiments and drink groups provided the least magnesium to the diet of subjects.

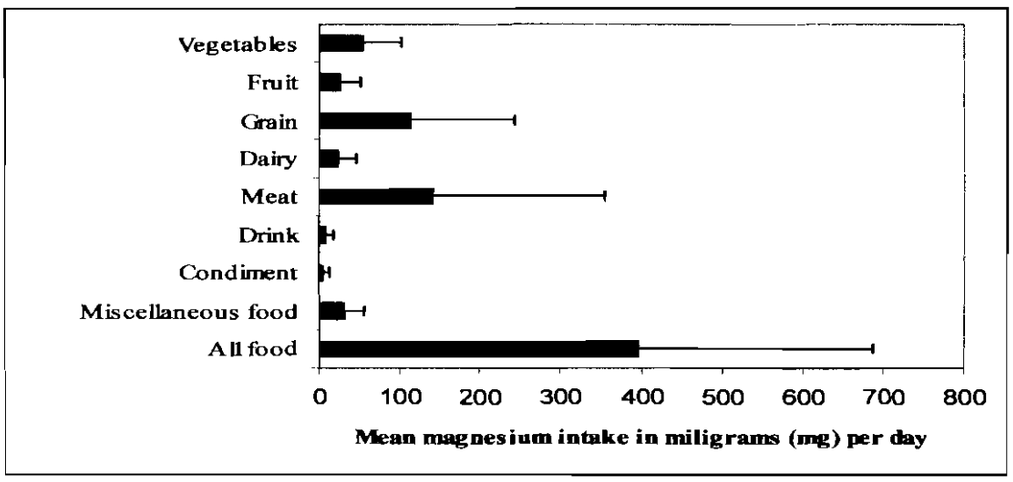

Figure 10. Mean magnesium intake per food group.

Of the 31 subjects, 45.2% (n=14) had a low magnesium intake. The 14 subjects with low magnesium intake included 57.1% (n=8) males and 42.9% (n=6) females. Further, 28.6% (n=4) of subjects with a low magnesium intake were born in the U.S. while the vast majority 71.4%, (n=10) were not born here. However, of those who were not born in the U.S. 70% (n=7) had lived here 15 years or longer. Therefore, 30% (n=3) of the subjects with low magnesium intakes lived here 0-14 years. Interestingly, of the 14 subjects who had a low magnesium intake, 85.7% (n=12) also had a low fiber intake.

Figure 11 shows the mean distribution of fiber intakes by food group as well as mean total fiber intake per day. The groups which provided the most fiber to the diet were grain, fruit and vegetables. Condiment, drink and dairy groups provided little to no fiber to the diet.

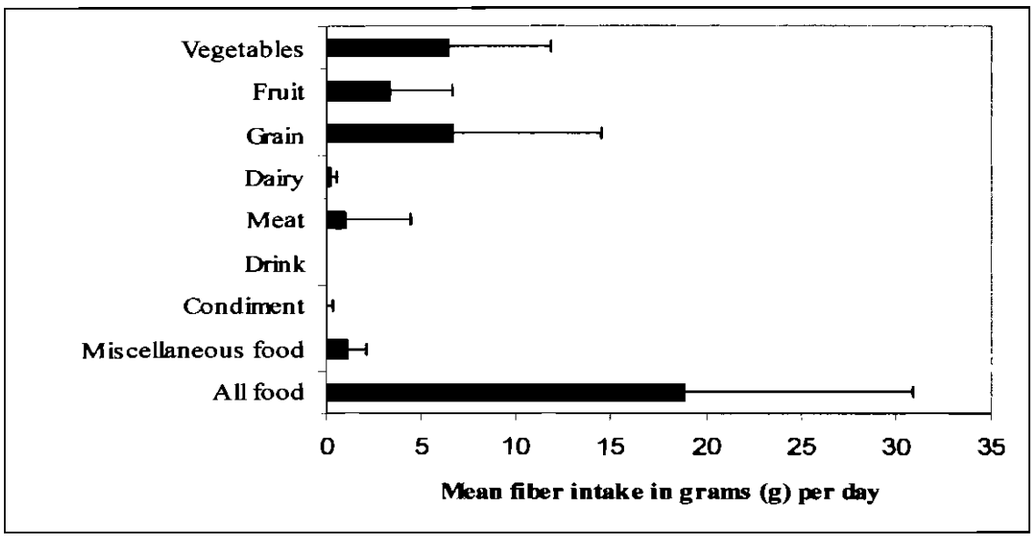

Figure 11. Mean fiber intake per food group.

Further results show that 17 subjects had low fiber intakes (less than 66% of the AI), ranging from 9.5% to 64.6% of the recommended amount of these subjects. Of the subjects with inadequate fiber intakes, 58.8% of subjects (n=10) were male and 41.2% (n=7) were female. Only 23.5% (n=4) of subjects with inadequate fiber intake were born in the U.S. Therefore, 76.5% (n=13) of subjects with inadequate intakes were not born in the U.S; subjects who lived here less than 15 years comprised 29.4% (n=5), while those who lived here for 15 years or longer consisted of 47.1% (n=8) of the subjects with inadequate fiber intake.

An adequate fiber intake was observed for 45.2% (n=14) of the subjects. Their intakes ranged from 66.8% to 208% of the recommended intake of fiber. Of the 14 subjects with an adequate fiber intake, 50% (n=7) of males and 50% (n=7) of females.

A t test analysis of mean inadequate and adequate magnesium intakes revealed significant differences in fiber and magnesium consumption, amounts consumed and number of risk factors for diabetes (see Table 10). This analysis demonstrated that subjects who had an adequate magnesium intake also had a significantly larger intakes of fiber from grains ($p<.01$, two-tailed

independent t test), Hmong American foods ($p<.05$), and all foods ($p<.001$). It appeared that those who had adequate magnesium intake also had an adequate fiber intake from vegetables but this finding was not significant. Those who had an adequate magnesium intake also consumed significantly more magnesium on average from grains ($p<.01$), dairy ($p<.05$), condiments ($p<.05$), Hmong American foods ($p<.01$) and all foods ($p<.001$). Food quantities eaten per meal were also significant. Subjects with adequate magnesium intake consumed larger quantities of meats ($p<.05$), dairy ($p<.05$), grains ($p<.001$), Hmong American foods ($p<.05$), and all foods ($p<.05$). Subjects who did not meet at least 66% of the RDA or AI also had significantly more total number of risk factors ($p<.001$) than those with an adequate magnesium intake (equal to or more than 66% of the RDA or AI).

Table 10

Adequacy of Magnesium Intake Compared to Mean Daily Intakes of Fiber, Magnesium and Food from Various Food Groups, and the Number of Risk Factors for Type 2 Diabetes.

Characteristic	Inadequate magnesium intake (< 66% of RDA)	Adequate magnesium intake (≥ 66% of RDA)
Mean fiber intake per day (g)		
Vegetables	4.56 (4.6)	7.91 (5.8)
Grains	2.44 (2.3)**	9.98 (3.8)**
Hmong American foods	4.16 (4.7)*	8.99 (6.7)*
All foods	11.35 (6.8)***	25.01 (1.8)***
Mean magnesium intake per day (mg)		
Grains	39.8 (38.3)**	170.68 (150.6)**
Dairy	12.93 (12.6)*	30.1 (28.9)*
Meat	42.46 (29.2)*	219.13 (268.8)*
Condiments	1.90 (3.6)*	6.73 (8.2)*
Hmong American foods	59.89 (64.3)**	156.62 (121.7)**
All foods	193.12 (94.5)***	562.98 (293.4)***
Mean amount per day		
Meats (ounce)	6.57 (4.3)*	32.45 (44.2)*
Dairy (cup)	.44 (.42)*	1.07 (1.0)*
Grains (cup)	2.22 (1.9)***	6.39 (3.8)***
Hmong American foods (cup)	3.71 (3.0)*	11.39 (12.0)*
All foods (ounce or cup)	50.53 (35.2)*	95.15 (58.5)*
Mean total number of risk factors	2.71 (0.7)***	1.24 (1.0)***

Note: SD is in parenthesis;*p<.05,**p<.01,***p<.001, independent sample t test

An independent t test analysis of mean low and adequate fiber intakes also revealed significant differences in fiber and magnesium consumption, food consumption, and number of risk factors for type 2 diabetes (Table 11). Compared to subjects with inadequate fiber intakes

(<66% of RDA), those who consumed adequate amounts of fiber (≥ 66% of RDA) also had significantly larger intakes of fiber, magnesium, vegetables, fruit, grains, Hmong American foods, and all foods. Lastly, subjects with adequate fiber intakes also had a significantly lower total number of risk factors ($p<.01$) for type 2 diabetes than those with inadequate intakes.

Table 11

Adequacy of Fiber Intake Compared to Mean Daily Intakes of Fiber, Magnesium, Food from Various Food Groups, and the Number of Risk Factors for Type 2 Diabetes.

Characteristic	Inadequate fiber intake (< 66% of RDA)	Adequate fiber intake (≥ 66% of RDA)
Mean fiber intake per day (g)		
Vegetables	4.27 (3.1)*	8.98 (6.6)*
Fruit	1.92 (2.9)**	4.92 (3.1)**
Grains	2.90 (2.4)**	11.04 (9.9)**
Hmong American foods	3.51 (2.5)**	10.82 (7.3)*
All foods	10.84 (4.7)***	28.57 (11.2)***
Mean magnesium intake per day (mg)		
Vegetables	35.55 (24.4)*	46.75 (59.2)*
Fruit	14.98 (23.1)**	39.14 (22.8)**
Grains	51.21 (48.2)**	184.87 (161.5)**
Hmong American foods	63.99(49.3)*	172.37 (134.0)*
All foods	243.89 (173.4)***	580.58 (302.8)***
Mean amount per day		
Vegetables (cup)	1.57 (1.0)*	3.38 (2.2)*
Fruit (cup)	0.88 (1.0)**	2.44 (1.6)**
Grains (cup)	2.86 (2.5)**	6.51 (4.0)**
Hmong American foods (cup)	4.22 (3.0)*	12.42 (13.0)*
All foods (cup)	56.07 (34.5)*	97.99 (64.2)*
Mean total risk factors per subject	2.41 (0.9)**	1.29 (1.1)**

Note: SD is in parenthesis;*p<.05,**p<.01,***p<.001, independent sample t test

Length of Time in U.S. and Magnesium and Fiber Intakes

An analysis of variance test revealed no significant difference between and within groups for magnesium and fiber intakes due to length of time living in the U.S. There was no significant

difference between the total magnesium intake (M=395.9 mg, SD=291.2) between subjects born in the U.S. and those who were not born in the U.S. Total fiber intake (M=18.8 g, SD=12.1) showed no significant difference between subjects born in the U.S or not born in the U.S.

Body Weight Status

The BMI for subjects ranged from 19.5 to 37.2 kg/m^2 in which 33% (n=10) of subjects were considered at risk for type 2 diabetes due to overweight or obesity. Of the 31 subjects, 50% (n=15) were 18-20 years old, including seven girls and eight boys. The BMI for all girls in this age group fell within normal weight range on the gender specific BMI-for-age growth chart. However, of the eight boys, 12.5% (n=1) was at risk for type 2 diabetes due to a BMI greater than 95^{th} percentile on the BMI-for-age growth chart. The seven boys who were not at risk for type 2 diabetes had a BMI between the 10^{th} and 95^{th} percentiles. Of the 16 subjects in the remaining age groups (Figure 12), 56.25% (n=9) were considered overweight or obese. Further examination of these data showed that one subject was considered obese class II, while eight were overweight. A breakdown within age categories indicates of the 11 subjects 21-25 years old, 45.45% (n=5) of them were overweight or obese while the remaining six were normal weight. Two subjects were 26-30 years of age and 50% (n=1) was overweight. One subject was 41-45 years old and was found to be overweight. Of the two subjects 51 or older, both (100%) were overweight.

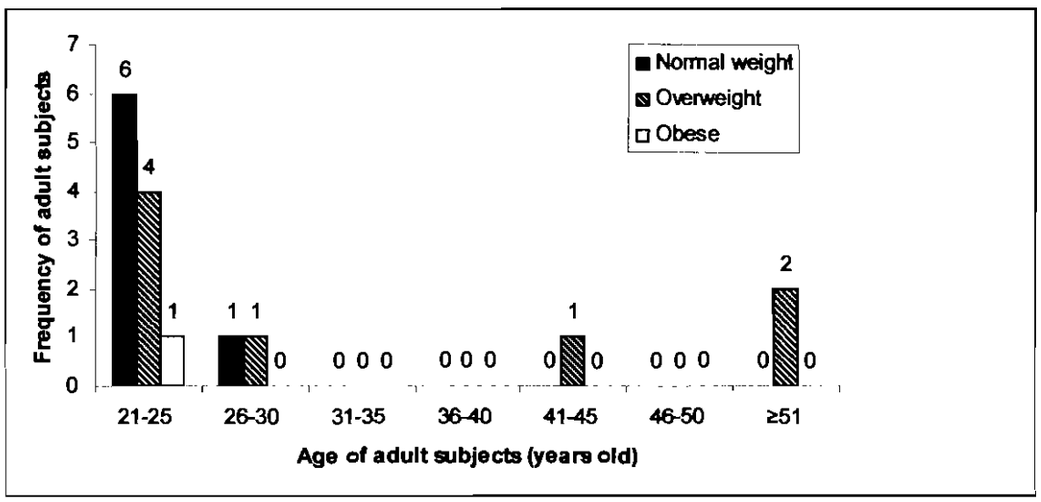

Figure 12. Distribution of body weight status by age of adult subjects.

A t test analysis of the fruit consumption of overweight or obese and normal weight subjects revealed significant differences in the amount of fruit consumed per day ($p<.05$), and magnesium and fiber intakes ($p<.05$) from fruit (Table 12). Overweight and obese subjects consumed on average significantly larger amounts of fruit consumed and more magnesium and fiber from fruit than normal weight subjects.

Table 12

Fruit Consumption by Body Weight Status

Fruit Consumption	Overweight or obese	Normal weight
Mean amount per day (cup)	2.64 (1.9)*	1.01 (1.0)*
Mean magnesium intake per day (mg) from fruit	40.5 (29.0)*	18 (21.4)*
Mean fiber intake per day (g) from fruit	5.11 (3.8)*	2.25 (2.7)*

Note: SD is in parenthesis;*$p< .05$; independent t test

Physical Activity

The percentage of subjects who attained adequate levels of 30 minutes per day for five days per week or 150 minutes per week of physical activity was 37.9% (n=11). Therefore, 62.1%

(n=18) of subjects did not meet the recommended physical activity level. There were two subjects (6.5%) who did not report physical activity and the data was considered missing. Of the subjects who had inadequate physical activity, 27.3% (n=3) were male and 72.7% were female (n=8). Adequate physical activity levels were represented by 72.2% (n=13) males and 27.8% (n=5) females. Interestingly, of the subjects with inadequate physical activity, 81.8% (n=9) were not born in the U.S. and 18.2% (n=2) were born here. Of those not born here, all of the subjects (n=9) had lived here ten years or more.

As seen in Table 13, the majority (n=21) of subjects walked as a form of physical activity. Volleyball and running were also performed often by 19% (n=6) of the subjects. Other forms of physical activity that were less common were tennis, hunting, biking, Pilates, sports and weightlifting. The subject who reported playing sports also reported a much higher amount of physical activity per week than other subjects and after including other activities from this subject it would be impossible to be physically active for the reported level.

Table 13

Types and Average Duration of Physical Activity among Subjects

Physical Activity	Mean total minutes/week
Walking	179.52 (n=21)
Running	96.67 (n=6)
Pilates	90 (n=1)
Sports	780 (n=1)
Volleyball	345 (n=6)
Tennis	30 (n=1)
Gardening	540 (n=2)
Hunting	240 (n=1)
Biking	30 (n=1)
Weightlifting	270 (n=1)

The survey asked the subjects "what keeps them from exercising?" Results for this question are presented in Table14. The most common barrier for exercising was school (n=9). Time, motivation and work were also common barriers to exercising observed with this sample.

Table 14

Barriers to Physical Activity Reported by Respondents

Barrier for exercising	Percentage of respondents (%)
School	25 (n=9)
Time	22 (n=8)
Motivation	13.9 (n=5)
Work	11 (n=4)
Clubs	8 (n=3)
Homework	5.6 (n=2)
Surgery	2.8 (n=1)
No open gym	2.8 (n=1)
Children	2.8 (n=1)
Movies/TV	2.8 (n=1)
Other commitments	2.8 (n=1)

A t test analysis of mean duration of physical activity (all types) revealed statistically significant differences for magnesium intake and total number of risk factors for diabetes (see Table 15.) Those who exercised 150 minutes or more per week had a higher average daily intake of magnesium (149.5 mg) from the grain group than those who did not have 150 minutes of physical activity. Similarly, those who failed to meet the recommended 150 minutes of physical activity per week had more total number of risk factors than those who met the recommendation for physical activity. Subjects who achieved the recommended level of physical activity tended to have higher fiber intakes from grains, lower fiber intakes from dairy and lower magnesium

intakes from condiments than subjects who did not attain the recommended level of physical activity. These results however were not statistically significant.

Table 15

Physical Activity Level Compared to Average Daily Fiber and Magnesium Intakes, and Mean Total Number of Risk Factors for Type 2 Diabetes

Average daily intake	< 150 minutes/week physical activity	≥150 minutes/week physical activity
Fiber (g)		
Grains	3.81	8.37
Dairy	0.45	0.03
Magnesium (mg)		
Grains	60.32*	149.50*
Condiments	8.04	2.16
Mean total # risk factors	2.55*	1.56*

Note: *p<.05, independent t test

Past Medical History of Subjects

When subjects were asked to identify diseases or disorders in their medical history, diabetes and high blood pressure was each reported by 3.2% (n=1) of the subjects (see Table 16). High blood cholesterol was not reported by any subject. None of the diseases or disorders was reported by more than 3.2% of the subjects.

Table 16

Past Medical History of Subjects

Disease/disorder	Percent of subjects		Missing data
	Yes	No	
Diabetes	3.2 (1)	96.8 (30)	0
High blood pressure	3.2 (1)	96.8 (30)	0
Stroke	3.2 (1)	96.8 (30)	0
Cancer	3.2 (1)	96.8 (30)	0
High cholesterol	0	96.8 (30)	3.2 (1)
Back problem/carpel tunnel	3.2 (1)	96.8 (30)	0
Hyperthyroidism/carpel tunnel	3.2 (1)	96.8 (30)	0
Kidney transplant	3.2 (1)	96.8 (30)	0

Note: Percentages are reported followed by n in parenthesis

Smoking

The question, "do you smoke?" was asked. Of the 31 respondents, 90% (n=27) responded that they never smoked in which 59% (n=16) of them were male and 41% (n=11) were female. Those who smoked consisted of 10% (n=3) of the sample; all 3 smoked 1-14 cigarettes per day. Of those who smoked, 67% (n=2) were female and 33% (n=1) were male.

A t test revealed significant differences ($P<.05$) between smokers and nonsmokers in the total number of risk factors for type 2 diabetes (Table 17). Nonsmokers had fewer risk factors than smokers. Also, those who smoked appeared to have a higher intake per day from drinks but differences were not significant.

Table 17

Smoking Habits Compared to Mean Total Risk Factors and Magnesium from Drinks

	Smoker (at risk)	Nonsmoker (no risk)
Mean total # risk factors per subject	3.33*	1.70*
Average magnesium/day drinks (mg)	19.34	6.43

Note: *p<.05, independent t test

Chapter V: Discussion, Conclusions, and Recommendations

This chapter contains information about findings of this research compared to other studies and these findings will be discussed. General conclusions will be summarized of important results. Lastly, recommendations will be made on logistics of the study, and to the subjects of the study.

Discussion

Age of subjects in this study may have influenced the results due to the majority of subjects being college students. There were only 2 subjects in the age range of 45 or older, the age that places subjects at risk of type 2 diabetes. However, a recent study by Copeland, Becker, Gottschalk, and Hale (2005) reported current rise in type 2 diabetes in adolescent age groups from 12-19 years old. The most populous age range in this study was 18-20 years old.

Risk factors not examined nor included in this study for type 2 diabetes mellitus were: previously identified polycystic ovary syndrome and gestational diabetes mellitus, impaired fasting glucose or impaired glucose tolerance, clinical HDL and triglyceride levels, and a measurement of hypertension. A self-report of hypertension was obtained in this study. Measurements should be made of these risk factors in future studies to obtain more objective data for the Hmong population.

The food groups in which daily intakes met recommendations were meat, and grains. An inadequate intake occurred with vegetables, fruit and dairy food groups. Guenther, Dodd, Reedy and Krebs-Smith (2006) reported only 40% of Americans met the recommended 5 servings of fruit and vegetables per day in 1999 to 2000.

For other food groups and nutrients studied, condiments provided primarily magnesium to the diet. The miscellaneous group provided both magnesium and fiber to the diet. Drinks only provided magnesium to the diet.

Due to the food frequency questionnaire, subjects may have had difficulty recollecting what they typically eat or may have over reported intakes of certain items. For instance, intakes of 20.78 oz meat per day and 43.23 cups of beverage were reported on average, which may be physically impossible. Over reporting may have occurred in the meat group due to misunderstanding of a "plate" being the equivalent of 3 cups of food. Many subjects reported eating more than one plateful of meat.

Some food items were consumed infrequently, but made an important contribution to magnesium and fiber intakes. French fries were the primary source of magnesium and fiber in the diet from the vegetable group. French Fries are not traditionally eaten by the Hmong population according to Ikeda (1992). The contribution of magnesium and fiber from French fries may be due to the large portions served at restaurants. Fruits that provided large amounts of magnesium and fiber were jackfruit and guava, traditional Hmong foods. The limited consumption of "native fruits" may be due to high cost or unavailability of these foods as reported by Ikeda (1992). The fruit consumed most often was fruit juice. White rice was the grain consumed most often which is to be expected from an Asian diet. Chocolate milk was the most consumed dairy item providing the largest amount of magnesium and fiber from the beverage group to the diet. In the meat group, tofu was consumed infrequently which is in disagreement to the findings of Ikeda (1992). Beef was consumed most often, in contrast to the findings of Ikeda (1992) who found that pork was the preferred meat. Water was the beverage consumed most often; however, tea was also consumed often. Tea is not a traditional drink for

the Hmong. Soda/pop/cola also not traditional drinks were one of the top four beverages consumed. Beef tallow was the most common condiment consumed, in contrast to the traditional pork lard reported by Ikeda (1992). The miscellaneous items examined in this study were common foods eaten by Americans in which the top ten most frequently consumed items were eaten by the Hmong subjects at least one time per week. The consumption of miscellaneous foods may demonstrate acculturation of American foods is occurring among the Hmong subjects in this study.

Magnesium intake was inadequate (less than 280 mg/day for males and 213.3 mg/day for females or less than 66% of the RDA) for 45.2% of the subjects, and adequate for 54.8% ($\geq$ 280 mg/day for males and $\geq$ 213.3 mg/day for females). Magnesium was contributed by all food groups studied; however, the largest contributors were the meat, grain and vegetable groups. Subjects with adequate intakes of magnesium tended to eat more fiber from grains, Hmong-American food, and all foods. Large portion sizes of meat, dairy, grain, Hmong-American food, and all foods were also consumed by subjects who met 66% or more of the recommended intake for magnesium. Due to the possible over reporting of meat intake and the large magnesium intake in meat, the average daily intake of magnesium may be inaccurate. There may be a larger number of subjects who did not meet the 66% RDA for magnesium due to possible over reporting meat intakes. However, further studies need to be performed to determine if the majority of subjects have an adequate magnesium intake with a more accurate report of meat consumption. However, those who reported adequate magnesium intake also had fewer total numbers of risk factors for type 2 diabetes. No difference was found in this study between dietary magnesium intake and weight status by using BMI calculations, in contrast to findings

Huerta et al. (2005) reported. This difference in findings may be due to the sample size of this research study.

Excluding the drinks group, all food groups, provided fiber to the diets of subjects, although the amount from condiments and the milk groups were small. The majority of subjects (54.8%) had an inadequate fiber intake. This inadequate fiber intake may be due to frequent consumption of refined carbohydrates such as white rice rather than whole grain products. Economic status, unawareness of health benefits of whole grains, spiritual beliefs or traditional habits may contribute to the frequent use of low fiber foods. The total number of risk factors present per subject was lower in those who met the fiber recommendations. The relationship between fiber and total number of risk factors suggests that to diets adequate in fiber from foods like grains, vegetables and fruits may translate to healthier diet or lifestyle choices for reducing risk of type 2 diabetes. More studies would need to be done to know the relationship between dietary fiber and the total number of risk factors for developing type 2 diabetes.

There was no significant relationship between the lengths of time living in the U.S. and magnesium or fiber intake. This finding may be a result of the small sample size or early stages of acculturation for the Dunn County Hmong population. Changes in magnesium and fiber intake are expected with length of time in the U.S. Kaplan, Huguet, Newsom, Bentson, and McFarland (2004) reported an increased incidence of obesity with length of residence in the U.S. Their study demonstrated a 9.4% obesity rate for those who lived in the U.S. for 0-4 years in which the obesity rate increased to 24.2% for subjects who lived here 15 years or longer. Kaplan et al. (2004) suggested the obesity rate may be due to acculturation of diets higher in fat and lower in fruits and vegetables paired with physical inactivity.

None of the subjects in the study were clinically diagnosed with type 2 diabetes mellitus, based on self-reports of medical histories. One subject reported a history of type 2 diabetes but never was clinically diagnosed with diabetes. This information was interpreted as the subject having a family medical history of type 2 diabetes.

Thirty three percent of subjects were found to be overweight or obese. Subjects who were overweight (BMI≥25 or BMI-for-age at or above the 95th percentile) consumed on average more fruit than those who were normal weight. The larger fruit intake among overweight subjects may be due to a larger consumption of food from all food groups or it may reflect a preference of these subjects for the taste of fruit and fruit juice compared other food groups. More males than females tended to be in the overweight category in this study but this finding was not significant. Lauderdale and Rathouz (2000) disclosed that 57% of males and 38% females were overweight in a study of 254,153 subjects. Lauderdale and Rathouz reported that the risk for becoming overweight or obese tended to directly increase with the number of years living in the U.S. Also, Asian Americans who were born in the U.S. are more likely to be overweight or obese than those who were foreign-born according to Lauderdale and Rathouz. This study did not find a significant mean difference in BMIs of foreign-born versus U.S. born subjects. Perhaps there was no significance due to the small sample size. The Hmong population is relatively new to the U.S. The subjects from this study may have been the first generation born here in which differences between BMI and length of time in the U.S. may not be detected until the second generation. A larger number of subjects over the age of 45 may also have given a better representation of length of time living in the U.S. and BMI.

Those who met physical activity recommendations were 62.1% of subjects in this study. According to Kruger, Ham, Kohl, and Sapkota (2004), 38.6% of Asians, Native Hawaiian and

other Pacific Islanders met physical activity recommendations whereas only 45.8% of the U.S. population met physical activity recommendations. Therefore, it appears that the Hmong population of Dunn County performed more physical activity than the national average of 2004. Although intensity was not assessed in this study most of the physical activities reported appear to be of moderate intensity such as walking or volleyball.

Subjects with adequate physical activity tended to have a larger fiber intake although findings were not significant. This report agrees with Schultze et al. (2007) who discovered participants who engaged in physical activity such as cycling and sports activities also had a higher fiber intake and were less likely to smoke. There was no attempt to identify athletes in this study.

An increased condiment intake tended to occur in subjects who did not maintain an adequate physical activity level. This finding may reflect a lack of knowledge about nutrition or an increased appeal of food items. Magnesium intake from grains was higher in those who obtained adequate physical activity. Although athletes were not identified in this study, Douglas and Douglas (1984) discovered a positive relationship between the number of seasons athletes participate in a sport and nutrition knowledge. More research needs to be done to determine if athletes obtain knowledge of energy sources specifically from grains that are rich magnesium. Identifying athletes in further studies in the Hmong population may also be beneficial.

Smoking habits were related to total number of risk factors and magnesium provided by drinks. Smokers tended to have more risk factors than nonsmokers. Although not significant, the mean magnesium intake from drinks tended to be increased in those who smoked compared to nonsmokers. Drinks containing magnesium consisted of beer, wine, coffee and tea. Therefore, those who smoked tended to drink more beverages with magnesium. Telivuo, Kallio, Berg,

Korhonen, & Murtomaa (1995) reported that smokers tended to have more frequent alcohol consumption as well as sugar consumption in tea and coffee.

Summary and Conclusions

The purpose of this study was to identify risk factors associated with type 2 diabetes in sample of Hmong living in Dunn County, Wisconsin. Overweight or obesity status determined by body mass index (BMI) calculations, frequency of food groups consumed, magnesium and fiber intakes, physical activity level, and past medical histories of diabetes, high cholesterol and high blood pressure were examined. Data was collected via a survey containing measures for type 2 diabetes risk factors and a quantitative food frequency questionnaire. Instruments were administered at the Dunn County WIC clinic and a meeting of the Hmong Stout Student Association at the University of Wisconsin-Stout over a three-month period. Thirty-one Hmong subjects participated in this study composed of 54.8% males and 45.2% females ranging from 18-60 years old.

This study found that the Dunn County Hmong subjects consumed adequate amounts of food from the drinks and meat groups; however, both of these groups may have been over reported. Grain consumption was also adequate. Vegetable intake approached the recommended daily intake. Intakes from the fruit and dairy groups failed to meet the recommended amounts. The largest sources of magnesium from each food group were French fries, bananas, oats, chocolate milk, beef, beer, fish sauce and potato chips. The largest sources of fiber from each food group were French fries, bananas, oats, chocolate milk, pork/ham, coconut cream and candy bars. Inadequate fiber was the only risk factor for type 2 diabetes observed among a majority (54.8%) of subjects. Adequate fiber intake was significantly associated with larger portion sizes as well as higher fiber and magnesium from vegetables, fruits, grains, Hmong foods, and all

foods. Adequate magnesium intake was significantly associated with higher daily food intakes and magnesium from grains, meat, dairy, condiments, Hmong foods and all foods. However, adequate magnesium intake was only significantly associated with fiber intake from grains, Hmong foods, and all foods.

Thirty-three percent of the subjects were at risk for type 2 diabetes by being classified as overweight or obese. Subjects who were overweight or obese consumed significantly more fruit than subjects of normal weight as well. The recommended amount of physical activity was met by 62.1% of the subjects in which walking and volleyball were the most common activities. The most common barriers to physical activity were school, time, motivation and work. Those of adequate physical activity level had significantly more intake of magnesium from grains and fewer total numbers of risk factors for type 2 diabetes mellitus. Smoking was uncommon with 87.1% of subjects being nonsmokers. Past medical histories revealed one subject with high blood pressure and one subject with a family history of type 2 diabetes.

Overall, Dunn County Hmong subjects had adequate physical activity, magnesium intake, and normal body weight status; they were nonsmokers and largely had no increased risk of type 2 diabetes due to past medical history, cholesterol level, high blood pressure, clinical diagnosis of diabetes, family history of diabetes or age. However, fiber intake was inadequate. No generalizations can be made from this study to the Hmong population due to the small sample size and invalidated instruments (survey and quantitative food frequency questionnaire) developed specifically for this study.

Recommendations

Several recommendations are made regarding the logistics of this study. Data collection and results would have been enhanced by finding a more representative sample of the Hmong

population, especially for groups over 45 years old (the age range for increased risk of type 2 diabetes). The Dunn County WIC clinic would have not been used as a resource for reaching Hmong subjects. Instead, by communicating with the elders of the Hmong community acceptance for participating in the study would have increased. Thus, organizing data collection at a church function or social gathering in addition to the Hmong Stout Student Association would have decreased collection time and increased the sample size. The instrument could have been enhanced by pilot-testing, and by adding more information to the survey and food frequency questionnaire. For instance, a question on the survey which ascertains how many meals times a subject eats per day would help clarify eating patterns. Similarly, an option would be added to the food frequency questionnaire or subjects to check if they never consumed a food item. This study would benefit from including waist-to-hip ratio measurements calculated by obtaining a waist circumference due to visceral body fat being an issue for the Asian population. Lastly, it would be beneficial to limit the sample to those aged 45 or older to be able to potentially analyze a larger sample with risk factors of type 2 diabetes.

A recommendation to the Hmong subjects is regular physical activity as well as eating a diet high in fiber to promote a healthy body weight and reduced risk factors for type 2 diabetes mellitus. Adequate physical activity and a healthy diet have a positive effect an individual's BMI. Therefore, focusing on two risk factors will affect three risk factors. Refraining from smoking would benefit the general health of the subject as well as eliminate a risk factor for type 2 diabetes mellitus. The majority of subjects were not at risk for type 2 diabetes by age; however, by monitoring lifestyle factors such as diet, exercise and smoking at a younger age may help with eliminating risk factors for type 2 diabetes in the future when age would become a risk factor.

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Appendix A

Consent to Participate in UW-Stout Approved Research

Title: Hmong Lifestyle Factors and Their Relationship to Type 2 Diabetes Mellitus.

Investigator: Tanya Becker **Research Sponsor:** Carolyn Barnhart

651-497-7737 715-232-2545
beckerta@uwstout.edu barnhartc@uwstout.edu

Description:
This is a study looking at the Hmong population at the Dunn County WIC to discover their eating habits, exercise habits, medical history, and age to determine if they have a risk for developing type 2 diabetes mellitus. This study will allow nutritionists in Dunn County to tailor their nutrition education to the needs of the Hmong population. This information will be used to teach disease prevention in the Hmong population.

Time Commitment:
This form will need to be signed to participate in the study. The time commitment is minimal for this survey. It will take approximately 20 minutes to fill out the survey and 5 minutes to measure your weight and height.

Risks and Benefits:
Participation in this study does not carry risk. However you will need to share personal information such as weight, age, gender, medical history, and eating and exercise habits. Some participants may feel embarrassed by their weight. However, this will be done in a private room with only the researchers present. The benefits of participating in this study include learning if the WIC population is living healthy lifestyles and whether or not they contribute to increasing risk factors for diabetes. Interventions will be tailored to target these risk factors. Also, by participating in this study you are helping to determine what works best in nutrition education for your population. General results will be available at the Dunn County WIC office in a handout format.

Minors:
If you are under the age of 18 years you are not eligible to participate in this study.

Confidentiality:
Your names will not be included on any survey documents; you will not be able to be identified by researcher. This form will not be kept with any of the other documents completed with this project and kept in a locked file. All the other data collected will be kept in a different locked file in which only the researcher and researcher's advisor will have access. At the completion of this research, all data that identifies you will be shredded.

Right to Withdraw:
Your participation in this study is voluntary. You may choose not to participate without any adverse consequences. You may withdraw from the study at any time.

IRB Approval:
This study has been reviewed and approved by The University of Wisconsin-Stout's Institutional Review Board (IRB). The IRB has determined that this study meets the ethical obligations required by federal law and University policies. If you have questions or concerns regarding this study please contact the Investigator or Research Advisor. If you have any questions, concerns, or reports regarding your rights as a research subject, please contact the IRB Administrator.

For any further questions or comments please contact:

Investigator: Tanya Becker
651-497-7737
beckerta@uwstout.edu

Research Advisor: Carolyn Barnhart
715-232-2545
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IRB Administrator:
Susan Foxwell,
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152 Vocational Rehabilitation Bldg.
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Statement of Consent:
By signing this consent form you agree to participate in the study entitled, Hmong Lifestyle Factors and Their Relationship to Type 2 Diabetes Mellitus.

Signature_____Date_____

Appendix B

Lifestyle Patterns – Dunn County, Wisconsin

This project has been reviewed by the UW-Stout IRB as required by the Code of Federal Regulations Title 45 Part 46

You may choose to not answer any question at anytime.

DIRECTIONS: Please check all boxes that apply.

1. Gender: Male Female

2. Age: 18-20 21-25 26-30 31-35 36-40 41-45 46-50 51 or older

3. Where you born in the United States? Yes No

4. If you were NOT born in the United States, how long have you lived here?
   0-4 years 5-9 years 10-14 years 15-19 years 20 years or longer

5. Who of your family live in the United States?
   great-great-grandparents great-grandparents grand-parents
   parents brothers/sisters children

6. What types of exercise do you do per week and for how long?
   For example: walking, running, biking, hiking, or playing sports.

	Type(s) of exercise	# times/week	How long? (minutes / hours)
1.			
2.			
3.			
4.			

7. What keeps you from exercising? _____

8. What is your medical history? (Check all that apply.)
   Diabetes Cancer
   High Blood Pressure High Cholesterol
   Stroke Other (please specify) _____

9. Has a health professional ever clinically diagnosed you personally with having diabetes?
   Yes No

10. Do you smoke?
    Never Smoked Former Smoker Current Smoker
    1-14 cigarettes/day 15 cigarettes/day or more

11. Do you eat snacks regularly during the day?
    No
    Yes – how many times per day do you snack? _____ times/day

12. How many times per week do you go to a restaurant or "quick place" to eat a meal?
    0 times/week once twice 3 times 4 times 5 or more times/week

DIRCTIONS: For the following **Food Frequency Charts** - please indicate the **numbers of times** you eat each of the foods listed per day, per week, or per month.
Also indicate **how many of each portions size** you typically eat during one meal.

	# times eat food per ...				# Portions Per Meal (enter number)			
A. Vegetables	**Day**	**Week**	**Month**		**1 Tbsp.**	**1/2 cup**	**1 cup**	**1 plate**
01. Mustard Greens								
02. Leafy Green Vegetable (Lettuce / Spinach / Kale)								
03. Tomato								
04. Eggplant								
05. Yard-long Beans								
06. Beans (green / yellow)								
07. Peas (sugar / snow / sweet)								
08. Leek (Chinese Onion)								
09. Onion (yellow / white / red / green)								
10. Kohlrabi								
11. Cabbage (green / red)								
12. Broccoli								
13. Cauliflower								
14. Zucchini								
15. Squash/Pumpkin								
16. Leaves of Pumpkin / Squash								
17. Sweet Peppers (green / yellow / orange / red)								
18. Chili Peppers								
19. Cucumbers								
20. Beets								
21. Carrots								
22. Celery								
23. Cucumbers								
24. Sweet Corn								
25. Cilantro / Parsley								
26. Chinese Parsley (Coriander)								
27. Bamboo shoots								
28. Potatoes								
29. French Fries								
30. Garlic / Shallots								
31. Other **Vegetable** (specify)								

	# times eat food per ...				Typical Amount Per Meal (check one)			
B. Fruit	Day	Week	Month		1 Tbsp	1/2 cup	1 cup	1 Each
01. Mango								
02. Guava								
03. Papaya								
04. Jackfruit								
05. Banana								
06. Apple								
07. Orange								
08. Grapes								
09. Pineapple								
10. Berries (Strawberries / Raspberries / Blackberries)								
11. Cranberries								
12. Pear (Asian / Bartlett / Bosc / D'Anjou)								
13. Peach / Nectarine								
14. Bitter Melon								
15. Melon (Cantaloupe / Honeydew)								
16. Fruit Juice								
17. Other **Fruit** (specify)								

	# times eat food per ...				Typical Amount Per Meal (check one)			
C. Grains	Day	Week	Month		1 Tbsp.	1/2 cup	1 cup	1 plate
01. Oats								
02. Cellophane or Mung Bean Noodles								
03. Rice (white)								
04. Rice (brown)								
05. Rice Soup								
06. Rice Noodles / Vermicelli								
07. Spaghetti (enriched)								
08. Other Pasta Noodles								
09. Ramen Noodles								
10. White Bread					Enter # of slices typically eaten:			
11. Wheat Bread					Enter # of slices typically eaten:			
12. Multi-Grain Bread					Enter # of slices typically eaten:			
13. Other **Grain** (specify)								

	# times eat food per ...				Typical Amount Per Meal (check one)			
D. Dairy	Day	Week	Month		1 Tbsp.	1/2 cup	1 cup	1 plate
01. Whole Milk								
02. 2% Milk								
03. 1% Milk								
04. Skim Milk								
05. Chocolate Milk								
06. Condensed Milk (sweetened)								
07. Egg					Enter # of eggs typically eaten:			
08. Ice Cream								
09. Cheese								
10. Cottage Cheese								
11. Yogurt								
12. Sour Cream								
13. Other **Dairy** (specify)								

	# times eat food per ...				Typical Amount Per Meal (check one)			
E. Meat	Day	Week	Month		1 ounce	1/2 cup	1 cup	1 plate
01. Chicken								
02. Turkey								
03. Beef								
04. Pork / Ham								
05. Processed Meat (Deli Meat / Hotdog / Sausage / Brat)								
06. Fish / Other Seafood								
07. Pigs Feet								
08. Tofu or Soybean Curd								
09. Venison								
10. Squirrel								
11. Pheasant								
12. Other **Meat** (specify)								

	# times eat food per ...				Typical Amount Per Meal (check one)			
F. Drinks	Day	Week	Month		1 Tbsp.	1/2 cup	1 cup	12-oz can
01. Water								
02. Tea								
03. Coffee								
04. Soda / Pop / Cola								
05. Beer								
06. Hard Liquor								
07. Wine								
08. Other **Drink** (specify)								

	# times eat food per ...				Typical Amount Per Meal (check one)			
G. Condiments	**Day**	**Week**	**Month**		**1 tsp.**	**1 Tbsp.**	**2 Tbsp.**	**1/2 cup**
01. Butter								
02. Margarine								
03. Mayonnaise								
04. Lard								
05. Beef Tallow								
06. Chicken Fat								
07. Coconut Milk								
08. Coconut Cream								
09. Fish Sauce								
10. Soy Sauce								
11. Pork Intestine, Chitterlings								
12. Other **Condiment** (specify)								

	# times eat food per ...				Typical Amount Per Meal (check one)			
H. Various Foods	**Day**	**Week**	**Month**		**1 Tbsp.**	**1/2 cup**	**1 cup**	**1 Each**
01. Sweetened Breakfast Cereal								
02. Pancakes								
03. Waffles								
04. Donuts								
05. Muffins								
06. Hamburger								
07. Cheeseburger								
08. Pizza								
09. Cream Soup / Chowder								
10. Chips (potato or corn)								
11. Pretzels								
12. Cookies								
13. Piece of Cake								
14. Candy Bar								
15. Any **Other** Food (specify)								

Thank you for completing this survey!

HEIGHT: _____ feet and _____ inches WEIGHT: _____ pounds

Appendix C

Supplementary Exchange Lists For Hmong American Foods

Food Group	Food	Portion
Starch/bread	Cellophane or mung bean noodles	¾ C.
	Rice vermicelli or noodles	½ C.
	Rice soup	¾ C.
	Yard-long beans,pods and seeds	½ C.
Meats and substitutes		
Lean meats	Pheasant	1 oz
	Squirrel	1 oz
	Venison	1 oz
Medium-fat meats and Substitutes	Pig's feet	2½ oz=2 exchanges
	Tofu or soybean curd, 2½ x 2¾ x 1 in	4 oz or ½ cup
High fat meats	Ground pork	1 oz
Vegetables (½ C. Cooked or 1 C. raw unless otherwise Indicated)	Bamboo shoots	
	Bitter melon, bittergourd	
	Chinese onion	
	Cucuzzi squash (spaghetti squash)	
	Luffa gourd/squash	
	Mustard greens	
	Mung bean sprouts	
	Pumpkin	
	Sugar peas, snow peas, sweet peas, peapods	
Fruits	Apple pear, Asian pear, raw, 2¼ in. high, 2½ in. diameter	1
	Guava, medium, raw	1 ½
	Jackfruit, raw	½ C.
	Mango, small, raw	½
	Papaya, raw, 51/8 in. high, 3½ in. diameter	½ or 1 C.
Fats	Beef fat	1 tsp
	Chicken fat	1 tsp
	Coconut cream or milk	1 Tbsp
	Coconut, raw	2 Tbsp
	Pork lard	1 tsp
	Pork intestine, chitterlings	½ oz
Free foods	Fish sauce	
	Pumpkin or squash blossom	
	Soy sauce	
	Tender vines and leaves of pumpkin, Squash, luffa gourd, and pea plants	
Occasional foods	Condensed milk, sweetened	1 oz= 1½ Starch/bread

Appendix D

INTERPRETER SCRIPT

Hello, my name is _____. Could you be so kind and participate in our survey to learn how to help you"The Hmong Population" in making your life healthy? This survey is very short and you would be helping us out a lot.

[If answer no]: Thank you for your time and have a wonderful day.

[If answer yes]: GREAT!! We really appreciate your time! I will read this form for you so that you know our intentions and your rights to partieipating in this survey.

[Read consent form]

Do you still agree to participate in this survey after explaining our intentions and your rights?

[If answer no]: Thank you for your time and have a wonderful day.

[If answer yes]: Alright, may we have your signature and today's date written on this line. [Show them the line to sign, after they sign place in locked consent form folder].

We are asking that you answer these questions as honestly as possible to be able to help you with our findings. This should not take long and you may choose not to answer a question if you feel uncomfortable. [Read questions on survey]

That is all the questions we are asking you today however, we do need 5 more minutes of your time to measure your height and weight. Please follow me.
[Enter WIC private room, close door completely after subject, and pull down shade]

I am now going to take your height and weight measurements. Could I ask you to take off your shoes so we get your true height and weight?
Thank you for taking your shoes off?

Please stand on this scale [point at scale]
Please look straight ahead and hold your head steady. [Make sure subject in Frankfurt plane by using ruler and take measurement for height. Immediately after taking height; take weight. Record information, and place survey in locked folder for surveys.]

You may step off the scale now.
Thank you so much! We are now done with the survey; you may put your shoes back on.
[While they are putting shoes back on, use an alcohol pad to sanitize the scale]

I thank you so much for participating that I will show you back to the waiting room were you are free to choose a healthy snack of your choice for helping us learn more about the Dunn county Hmong population. Thank you again for your kindness!

The results of this study will be given to the Dunn County WIC office in a form of a handout if you will be interested in knowing the conclusions of this study. Thank you so much!