UNIVERSITY OF NORTH TEXAS
HEALTH SCIENCE CENTER AT FORT WORTH
1970

Nadkarni, Neetee A. <u>The Public Health Impact of Type 2 Non-Insulin Dependent Diabetes Mellitus in Asian Indians, Chinese and Japanese</u>. Master in Public Health (Community Health), August 2001, 22pp, 4 tables, bibliography. The prevalence of type 2 non-insulin dependent diabetes mellitus (NIDDM) is increasing in Asians, especially among Asian Indian, Chinese and Japanese populations. This increase will have a severe impact on the health and well being of these populations. In 1997, a health survey from the World Health Organization (WHO) found numbers of adults with NIDDM in Asian Indians, Chinese and Japanese populations to be first, second and fifth, respectively [14]. According to the National Commission on Diabetes, "it is not known how the course, the complications and mortality from diabetes among subgroups of the United States population compare with the same factors for persons with diabetes of the same ethnic origin in the homelands" [12]. This review article focuses on the number and prevalence of NIDDM and risk factors contributing to the disease among these Asian sub-populations. This goal of this paper is to provide information to health and medical researchers, practitioners and community planners for use in public health interventions in the United States, India, China and Japan. The results of this paper direct attention to the migrant Asian Indian, Chinese and Japanese populations because the prevalence of NIDDM is increasing rapidly in these groups.

THE PUBLIC HEALTH IMPACT OF TYPE 2 NON-INSULIN DEPENDENT DIABETES MELLITUS IN ASIAN INDIANS, CHINESE AND JAPANESE

PROBLEM IN LIEU OF THESIS

Presented to the School of Public Health

University of North Texas
Health Science Center at Fort Worth

in Partial Fulfillment of the Requirements

for the Degree of

Master of Public Health

By

Neetee Nadkarni, B.A.

Fort Worth, Texas

August 2001

THE PUBLIC HEALTH IMPACT OF

TYPE 2 NON-INSULIN DEPENDENT DIABETES MELLITUS

IN ASIAN INDIANS, CHINESE AND JAPANESE

Neetee Nadkarni, B.A.

APPROVED:

Major Professor

Committee Member

Committee Member

Department Chair

Dean, School of Public Health

TABLE OF CONTENTS

LIST OF TABLES

The Public Health Impact of Type 2 Non-Insulin Dependent Diabetes Mellitus in Asian Indians, Chinese and Japanese

Neetee A. Nadkarni,
Ximena Urrutia-Rojas, DrPH, Antonio Rene, Ph.D., Sue Lurie, Ph.D.
School of Public Health, University of North Texas Health Science Center, Ft. Worth, Texas

(361) 994-7261- Home Phone Number
(707) 235-1831- Cell Phone Number
Babudi@aol.com – Email Address

Key Words: Asian Indian; Chinese; Japanese; NIDDM (Non-insulin dependent diabetes mellitus); Prevalence

ABSTRACT

The prevalence of type 2 non-insulin dependent diabetes mellitus (NIDDM) is increasing in Asians, especially among Asian Indian, Chinese and Japanese populations. This increase will have a severe impact on the health and well being of these populations. In 1997, a health survey from the World Health Organization (WHO) found the numbers of adults with NIDDM in Asian Indians, Chinese and Japanese populations to be first, second and fifth, respectively [14]. According to the National Commission on Diabetes, "it is not known how the course, the complications and mortality from diabetes among subgroups of the United States population compare with the same factors for persons with diabetes of the same ethnic origin in the homelands" [12]. This review article focuses on the number and prevalence of NIDDM and risk factors contributing to the disease among these Asian sub-populations. This goal of this paper is to provide information to health and medical researchers, practitioners and community planners for use in public health interventions in the United States, India, China and Japan. The results of this paper direct attention to the migrant Asian Indian, Chinese and Japanese populations because the prevalence of NIDDM is increasing rapidly in these groups.

INTRODUCTION

According to World Health Organization (WHO) health surveys, the prevalence of type 2 non-insulin dependent diabetes mellitus (NIDDM) was projected to increase from 1995 to 2025 by 170% (from 84 to 228 million) in most developing countries [15]. In 1997, this survey found that Asian Indian, Chinese and Japanese populations were first, second and fifth in prevalence of NIDDM, respectively [15].

Diabetes is a condition where an increase in the level of glucose in the blood causes glucose to collect in the body's circulation instead of going into cells. The "build-up" of glucose in the blood causes the body's cells to be starved for energy, or on a long-term basis, causes damage to the tissues of the eyes, kidneys, nerves, or heart. NIDDM is defined as the inability of insulin to suppress non-estrified fatty acids, which causes continued hepatic glucose production [6]. This form of diabetes is the most common form of diabetes in Asians, and until recently, it occurred predominantly in adults. However, the prevalence in young Asian children is also increasing [14,17]. The WHO classification of NIDDM is based on a fasting blood glucose value, or the blood sugar level taken two hours after a 75g challenge of glucose taken orally (Table 1) [1,2,3,5,6,7,12, 13,15]. Risk factors for NIDDM are obesity, lack of physical activity, age, race or ethnicity, family history of diabetes and Acanthosis Nigricans (ADA, 2000). Several studies testing the correlation of physical exercise and NIDDM have concluded that physical exercise and decreased prevalence of NIDDM are positively correlated [5,6,7,10,11]. However, a study among Asian Indians by Ramchandran et al (1997), found no correlation between the amount of physical exercise and prevalence of NIDDM [2].

Treatment of NIDDM includes planning proper times and foods per each meal, weight loss and increasing exercise. Meals should be low in fat, and include proper amounts of proteins and carbohydrates. Exercise also helps lower blood sugar, because it increases the activity level of the cell, causing an increased need for energy from sugar.

This review of literature is focused on articles that study the number and prevalence of NIDDM in Asian Indian, Chinese and Japanese sub-populations. The articles were chosen based on the study population, location and risk factors studied. The goal of this paper is to provide available information to health and medical researchers, practitioners and community planners for use in public health interventions. Asian Indians, Chinese and Japanese were chosen because these populations have a high rate of prevalence of NIDDM, but comparatively there is a lack of published research regarding NIDDM prevalence. These populations are also increasing in size in the United States and will require specific NIDDM health interventions. The 2000 census has listed the Chinese, Japanese and Asian Indian populations as first, third and fourth in number among Asians residing in the United States [18].

For the purposes of this paper, native Asians are defined as those individuals who are descendents of their respective country and still reside in the country of origin. For example, a Japanese native is a person of Japanese descent who lives in Japan. This definition is used to focus the sample population reviewed in the published studies. Another definition applied for the use of this paper was the definition of an Asian in western industrialized countries. These Asians are those individuals who are of Asian descent, but reside in a western industrialized country. For example, a Japanese American is a person of Japanese descent, who is living in the United States.

This review article is the result of a literature search performed using Medline. Articles were chosen based on the criteria of content, location and date of publication. Articles were chosen if the study population was Asian-Indian, Chinese, or Japanese and the study focused on the prevalence of NIDDM. The articles were limited by date of publication between the years of 1960-2001. Articles were also limited to studies that focused on the prevalence of NIDDM. For example, articles that focused on cardiovascular disease, but mentioned an increase of NIDDM as a side effect were eliminated.

Thus far, there appears to be a lack of NIDDM research on Asian Indian Americans and Chinese Americans in the United States and Japanese individuals in Japan. There have been numerous studies conducted on the migrant Asian Indian population in South Africa, the United Kingdom and in other areas of Europe, as well as the Asian Indian population in India [5,6,7] Research on the prevalence of the native Chinese population in China is also available [16,17]. Similarly, there are numerous studies in the literature focusing on the Japanese American population in the western parts of the United States [10,11,12,13].

NIDDM prevalence has increased rapidly in several Asian countries and populations due to changes in lifestyle, increased westernization, urbanization [17]. The largest occurrence of NIDDM has occurred in the developing countries India and China [17]. Risk factors for NIDDM among Asians include increasing age, central obesity, decreased physical exercise, race or ethnicity, diet family history of diabetes and presentation of Acanthosis Nigricans [1,25,6,7,8,9,10,11,21].

Developing countries also have an increased risk of NIDDM prevalence and other chronic diseases due to increases in life expectancy. There has been a shift from a high prevalence of infectious (communicable) diseases to a high prevalence of chronic (non-communicable) diseases [17]. Often, this shift occurs rapidly, and the country undergoes an increase in both infectious and chronic diseases for a period of time. Many Asian countries are in this stage of development, and so are afflicted with several health risks [17].

Prevalence of NIDDM in Native Asians and Asian Americans

Asian Indians. Asian Indians have the highest number of adults with NIDDM according to WHO health surveys (3.8% prevalence) [2,15]. Asian Indian health researchers have found a steady increase in the prevalence of diabetes cases in Asian Indians [1,2,3]. The WHO International Diabetes Survey found that India, among all nations, had the largest number of individuals with NIDDM in 1997 and was projected to have the largest number of people with NIDDM in 2025, (20 and 57 million respectively). The increase in Asian Indian diabetics in India between 1995 and 2025 is expected to be a 195% increase [15] (Table 2).

Banerji et al. tested the relationship between insulin action and the amount of visceral, abdominal subcutaneous (SC) and total adipose tissue in an Asian Indian population in South India [1]. The investigators also examined the relationship of Body Mass Index (BMI) and prevalence of

NIDDM. An inverse relationship of visceral adiposity with insulin action was found [1]. It was concluded that an increase in visceral adiposity causes an increased risk of developing NIDDM and an increased insulin resistance. The results of this study also found that Asian Indian men had an increased risk of NIDDM and increased rate of insulin resistance (about 2/3 of the subjects) despite a non-obese Body Mass Index reading. It was concluded that an unknown triggering factor in Asian men was causing an increased insulin resistance and increased prevalence of diabetes. The researchers also found that Indian individuals in rural India had a NIDDM prevalence of 2%, while their urban Indian counterparts had a NIDDM prevalence of 11%. The NIDDM prevalence in Asian Indian migrants in the United States, South Africa and United Kingdom increased even more to 16% [1].

Ramchandran et al found similar results regarding the prevalence of NIDDM in Asian Indians in another study [2,3]. In this study, the researchers agreed that genetic and environmental factors strongly affected the prevalence of NIDDM, so they tested the effects of the temporal factor on the prevalence of NIDDM in urban Asian Indian adults [2,3]. The researchers first evaluated an urban Asian Indian population [3] and then re-evaluated a similar group five years later [2]. The investigators concluded that the prevalence of NIDDM in the population had increased 40% in the period of five years. In addition, the researchers evaluated subjects' BMI, Waist-Hip Ratio (WHR), amount of physical exercise and impaired glucose tolerance levels. It was determined that the amount of physical activity was not positively correlated with an increased risk of NIDDM. However, the risk factors of age, WHR, BMI, and gender play a strong role in the development of NIDDM, starting with the strongest effect to the weakest effect, respectively. Diet was mentioned as a risk factor of NIDDM in this study. In this study women had a higher prevalence of NIDDM [2,3]. However, a national Asian Indian urban diabetes study demonstrated that the male and female population were nearly equally predisposed to the disease and that one in eight Asian Indian adults in the country had diabetes [15].The first study by Ramchandran et al (1992) also listed urbanization, family history and upper body obesity as a strong risk factors [3]. Ramchandran et al. also concluded that migration of

Asian Indians from rural India to urban India increased the prevalence of NIDDM due to changes in environment, lifestyle and diet [2,3].

Asian Indians in Western Industrialized Countries. There are a large number of Asian Indian migrants throughout the United States, however, there have been few diabetes-related studies conducted on this population. Although research on Asian Indian migrants exists in Europe and Africa, Banerji et al and Laws et al are the only published studies found that display some information on the situation of Asian Indian Americans in the United States [1,4]. The research study by Banerji et al also found that Asian Indian Americans were more hyperinsulinemic when compared to Caucasian individuals [1]. Asian Indian Americans were shown to have an increased prevalence of NIDDM, even without an increase in BMI [1]. In addition, there is also an increased level of plasma glycerol, despite increased insulin levels, in Asian Indian Americans when compared to European Americans [4].

Much of the research done on Asian Indian migrants is focused in South Africa and the United Kingdom. Omar et al. studied an Asian Indian migrant population in various parts of Durban, South Africa [5]. The subject population was limited to descendents of Asian Indian migrants between the years 1860-1911. Researchers controlled socio-economic status by choosing individuals from both affluent and non-affluent communities. The goal of this study was to determine the prevalence of NIDDM and impaired glucose tolerance (IGT) levels [5]. The investigators found that obesity was strongly linked to the prevalence of NIDDM and IGT in Asian Indian migrant women. The research findings also showed a crude NIDDM prevalence of 9.8% and a crude IGT prevalence of 5.8% [5].

McKeigue et al. hypothesized in their study that glucose intolerance and body fat pattern are inter-related [6]. An increased accumulation of abdominal fat and increased waist circumference was found for Asian Indian migrants in London, United Kingdom, when compared to Europeans in the same area. This increased abdominal fat without generalized obesity is unique to only a few populations, including the Asian Indian migrant population. Most other populations with an increased risk of NIDDM often have an increased BMI and generalized obesity, such as the Pima Indians and Nauruans [6]. It was also found that Asian Indian migrant women have a stronger association with glucose intolerance and central obesity than Asian Indian migrant men [6]. Waist, hip and thigh girths were measured in order to get an accurate anthropometric measurement. Skin-fold thickness ratios of the triceps and the anterior thigh were also measured to calculate the amount of body fat [6].

In a similar study, the relationship between central obesity and insulin resistance was correlated with NIDDM [7]. This study was also conducted in London and focused on the Asian Indian migrant populations compared to the European population. The prevalence of NIDDM in Asian Indian migrants was found to be significantly higher than that of the European population (19% versus 4%, respectively). This prevalence is approximately 4.3 times as great in Asian Indian migrants than Europeans. The Asian Indian migrant population was also found to have a greater waist-hip ratio than their European counterparts. The researchers concluded that this might make Asian Indian migrants more susceptible to an insulin resistance syndrome and central obesity [7]. The results of the study predict that physical exercise and control of obesity would help decrease the prevalence of NIDDM among Asian Indians.

***Japanese*.** NIDDM is a serious health concern affecting millions of Japanese individuals in Japan and throughout the world. The WHO diabetes health survey found Japan to be the fifth highest country in the number of adults with diabetes in the year 1997 (6.5% prevalence) (Table 2). Kitazawa et al. studied the prevalence of NIDDM in Tokyo, Japan [8]. The WHO criteria for diagnosis was followed. Researchers concluded that men had an increased prevalence of NIDDM as compared to women, 4.0% and 2.2%, respectively. Although the reason for this finding was not mentioned in the paper, it may be due to an overall increase in BMI and intra-abdominal fat in men subjects compared to women subjects [20]. This prevalence of NIDDM also increased with age [8]. Diabetic retinopathy was found to be 4.3% of this population. Researchers also concluded that an increase in fasting blood glucose may be an indicating factor to warn of glucose, and can be used as a screening tool [8].

Takashima et al. also studied the prevalence of NIDDM in Japan. However, their study focused on more of the rural population of native Japanese individuals [14]. This study was focused in the rural areas of Tobuku and Kyushu. The study results showed an increased prevalence of NIDDM in Japanese men compared to women. The total rural prevalence was concluded to be 4.9% [14]. Researchers speculated that this number may have been higher than expected due to the increased urbanization of rural areas and because living standards between the urban and rural areas of Japan are becoming more similar. Obesity, hypertension, proteinuria, hyperlipidemia and hyperuricemia were considered to be risk factors, since they contribute to the increased prevalence [14].

Japanese in Western Industrialized Countries. Huang et al. studied the prevalence of NIDDM and the role of acculturation to a Western lifestyle in the prevalence of NIDDM in Japanese Americans in Hawaii. The Honolulu Heart Program studied men of Japanese descent in Japan, Hawaii and California [10,11]. This study did not use the WHO criteria for NIDDM prevalence diagnosis. Instead, glucose was measured in a non-fasting state, one hour after a 50 g glucose load was delivered [11, 12]. The Japanese American subjects were limited to male descendents of Japanese migrants between the years 1900-1919. The researchers noted the prevalence of native Japanese individuals in Japan was fairly low. Acculturation was tested with a series of questions about diet, years spent in Japan and place of birth. Researchers noted the increase in acculturation was inversely correlated with an increased prevalence of NIDDM. This is due to the change in diet, physical exercise and lifestyle of Japanese Americans. Japanese Americans' diet included more animal protein and fat, while their physical exercise decreased [10]. Aging, obesity and a lack of physical exercise were also found to be risk factors for NIDDM. Researchers found a reduced prevalence of NIDDM was present in those Japanese Americans who had retained a more traditional Japanese lifestyle. They also found that living in Japan was associated with a lifestyle that incorporated increased physical exercise, a decreased BMI and a decreased level of obesity. Japanese male migrants in Hawaii were two times as likely to be afflicted with NIDDM than their Japanese male counter-parts [10].

Burchfiel et al. also used Honolulu Heart Program data in their study to analyze the prevalence of NIDDM in male Japanese Americans [11]. The focus of this study was to ascertain the role of physical exercise on NIDDM prevalence [11]. The Honolulu Heart Programs study concluded Japanese Americans have experienced a higher prevalence of NIDDM than in Japan. The lifestyle factors include consumption of a diet higher in saturated fat and reduced physical activity. A consequence of this is the development of central (visceral) adiposity, insulin resistance, hypertension, and coronary heart disease [11]. Research conducted suggests that lifestyle factors associated with 'westernization' play a role in bringing out this susceptibility to diabetes. Physical exercise was measured in quintiles (basal, sedentary, slight, moderate and heavy) and correlated with the prevalence of NIDDM. Study results demonstrated that prevalence of NIDDM was inversely related to physical exercise [11]. Those subjects who were performing heavy exercise were the least likely to be affected by NIDDM. BMI was also measured in relation to amount of physical exercise. Results showed BMI and obesity decreased with increased physical exercise [11].

Studies on the prevalence of NIDDM in Japanese American men have also been performed in Washington State [12,13,18]. Fujimoto et al. have published several articles on the prevalence and effects of NIDDM in Japanese American men [12,13,18]. They found that Japanese-American diabetics did not seem to have the obesity associated with other diabetic populations. By using CT-scanners, researchers found larger deposits of abdominal fat, which have been found to carry higher risk of diabetes than fat in other parts of the body [12]. The complications of Nisei (Second generation Japanese Americans) in relation to NIDDM include retinopathy, ischemic heart disease, peripheral vascular disease, hypertension, neuropathy and nephropathy were analyzed using WHO standards [12, 15]. An increased prevalence of retinopathy and neuropathy was noted in Nisei men with NIDDM compared to men with IGT or normal glucose tolerance (NGT) levels.

Hypertension, peripheral vascular disease and ischemic heart disease all were higher in diabetic Nisei men, but were still present in Nisei men with IGT and NGT [12]. For the purposes of this study, Nisei men were defined as the descendents of Japanese migrants born in Washington State between 1910 and 1939 [13]. The prevalence of NIDDM in Nisei Japanese Americans was twice that of the Caucasian population in the King County (13% versus 7% respectively) [13,18].

Brazil has a large number of Japanese migrants. In fact, the largest population of Japanese migrants is in Brazil [18]. In 1987, a survey of first and second generation Japanese migrants estimated the prevalence of NIDDM in Brazil. The survey population included 747 first generation and 1017 second generation Japanese migrants. The results of this study were similar to the results found in Fujimoto et al [12,13]. First generation Japanese migrants had a NIDDM prevalence of 11% (men) and 13% (women). Second generation Japanese migrants had a NIDDM prevalence of 11% (men) and 8% (women) [18].

Chinese. China has the second highest number of adults with diabetes (2.0% prevalence) in the world (Table 2). This may be due to the rapid increase in population, westernization and urbanization in this country [17]. For the purposes of this paper, the native Chinese population included those individuals who are of Chinese descent living in China, Taiwan and Hong Kong. NIDDM prevalence has been increasing in Taiwan and has now become the fifth leading cause of death in this country [16]. This research team found the risk factors of age, baseline glucose levels and obesity to be important in predicting NIDDM occurrence.

A paper by Cockram focused on the prevalence of NIDDM in several Asian-Pacific countries [17]. He concluded that in the Chinese population, obesity and NIDDM prevalence often occur in relation to one another. However, the normal definition of obesity (BMI > 29 kg/m^2) is lower for this population, because NIDDM prevalence begins occurring at lower BMI levels [17].

The prevalence of NIDDM in Hong Kong has increased rapidly since 1990 [17]. The prevalence of NIDDM was found to be approximately 7.7% of the population. This prevalence increased to 8.9% in 1995. The situation in Taiwan is similar, with prevalence of NIDDM increasing from 9.0% to 11.0% from 1994 to 1995, respectively [17]. This research data was obtained by the researchers using WHO criteria.

Cockram also reviewed NIDDM prevalence in China. The prevalence of NIDDM differed as the location of the survey was changed from urban to rural. The prevalence of NIDDM in 1980 of rural China compared to urban Shanghai, China was 0.33% and 1.0%, respectively [17]. In a 1993 survey performed in urban Beijing, China the NIDDM prevalence was measured at 3.63% of the population. Recent trends of rising NIDDM prevalence due to increased urbanization are apparent. In 1999, Shanghai, China was again surveyed to check NIDDM prevalence. This time the estimated prevalence was believed to be 6% [17].

Chinese American in Western Industrialized Countries. The Chinese American population is the largest Asian population in the United States. According to the 1990 census, approximately 1.6 million Americans are Chinese or of Chinese descent [17]. In the 2000 census, this number has increased to approximately 2.4 million Americans of Chinese descent [22]. Due to these large numbers, any health problem that affects this population is an important public health concern. Sloan studied the prevalence of NIDDM in Chinese individuals in Hawaii. The study concluded that Chinese American had an increased prevalence of NIDDM when compared to Caucasian Americans and compared to Chinese individuals in China [19]. The prevalence of NIDDM in the Chinese American population in Hawaii was found to be 14.6%, while Caucasian Americans in Hawaii had an NIDDM prevalence of 7.3% [19].

Fujimoto mentioned the study by Choi et al., which tested the prevalence of NIDDM in Chinese Americans in Boston, Massachusetts, in his review of literature. This study measured the risk factors associated with cardiovascular disease in relation to NIDDM in Chinese Americans. The study results showed that the NIDDM prevalence in Chinese American men and women was 12.5% and 13.3, respectively [18].

A study performed in Mauritius, an island in the Indian Ocean, also studied the prevalence of NIDDM in Chinese migrants [18]. The Chinese migrant population in Mauritius consists of 2% of the total population. This study found that male Chinese migrants had an increased prevalence of NIDDM compared to female Chinese migrants, which were 16% and 10%, respectively [18].

Discussion

Asians are often thought of possessing longevity in life, but recent trends in health conditions are causing changes. The prevalence of NIDDM is high and is increasing among the Asian sub-populations, when compared to other ethnicities. As the studies by Banerji et al and Fujimoto et al point out, the prevalence of NIDDM in Asian Indian American and Japanese American populations increases as they move away form their homelands, respectively. Research by Cockram demonstrates the need for public health awareness and education in Asian populations in the United States and in their native Asian countries. NIDDM prevalence in Asian Americans is an important medical and public health issue since there is an increasing number of Asians in the United States. Intervention programs targeted at these populations may help decrease or control the prevalence of NIDDM in the United States. Focusing the public health programs on Asian diet, physical exercise and educational seminars can help reach these populations.

The Asian Indian diet is comprised primarily of carbohydrates, lacking sufficient protein intake. Since many Asian Indians are vegetarian, rice and tortillas are a primary staple in each meal. Protein is often in the form of lentils and beans, instead of meats. Changes in diet may contribute to the increased risk of NIDDM in this population. Asian Indians also have an increasing number of cardiovascular disease (CVD) cases, which is strongly associated with NIDDM [1,2,3,47]. This association between CVD and NIDDM prevalence may be genetically pre-disposed in this population. Therefore, use of foods with large amounts of fats and foods cooked in oils, may put Asian Indians at an increased risk of CVD and NIDDM.

The Japanese diet consists of the staple, rice. This increased amount of rice (carbohydrates) in the Japanese diet can cause an unbalanced diet. However, Japanese individuals also use many vegetables and fish as part of their diet. The fish is often eaten raw as sushi, and the vegetables are often either grilled or pickled. Soy sauce and meso soup, both derived from soy beans are also used in order to provide protein. Overall, the Japanese diet is fairly healthy. However, there is an increased prevalence of NIDDM in recent years in this group. The Japanese population is experiencing many changes in lifestyle, including changes in diet and physical exercise. This change away from traditional Japanese lifestyle is causing many Japanese individuals to fall susceptible to NIDDM.

There has been a rapid increase in the prevalence of NIDDM in a short period of time in China. As stated previously, this maybe due to the increasing population of this country or the recent, rapid urbanization. Whatever the cause, the fact still remains that in the past few years, China has had a sharp increase in NIDDM cases. This increase is more evident in the urban populations, but is increasing in the rural areas as well. The Chinese diet is generally similar to other Asian diets, which have been found to have a more protective effect. However, as urbanization and westernization occur, there is often a shift towards a more Western diet.

The prevalence of NIDDM in Asian Americans is higher than found in their native countries. This may be attributable to the change in diet, change in physical exercise or any other lifestyle change. This change towards a "westernized" diet may include increased amounts of meats, fast foods and soft drinks. The lifestyle changes include a decreased amount of physical exercise. In Asian countries, many people often travel from one place to another by walking or riding their bicycle. While most Asian Americans in the United States, take the bus or drive their cars for transportation. This lifestyle change may seem minute; however, it may be significant in a population that may be genetically pre-disposed to diseases such as NIDDM. The prevalence of urban native Asians is also higher when compared to the rural native Asians. However, westernization may not be the sole factor playing a role in the increase of NIDDM prevalence between the rural and urban areas. Instead, this increase in NIDDM prevalence may be resulting due to differences in study methodology used in rural and urban areas, e.g. screening programs. Further research to study the increase in NIDDM prevalence between rural and urban areas needs to be done.

Most of the research articles reviewed in this paper correlated lack of physical exercise with an increased NIDDM prevalence. Studies testing all three Asian sub-populations found that physical exercise helped decrease BMI and obesity levels [5,6,7,10,11], both of which are highly correlated with NIDDM. Physical activity scores were also reduced in Asian Indians compared to their European counterparts, which may help account for increased rates of NIDDM in the former group [6,7]. The Honolulu Heart Program also measured the level of physical activity of each Japanese test subject. Conclusions from this study demonstrated that those Japanese American men who were less acculturated to the western lifestyle maintained an increased level of physical exercise in their life and a had decreased prevalence of diabetes, when compared to Japanese American men that were more acculturated to the western lifestyle [10,11].

Fujimoto theorizes that this westernization may play a role in the "thrifty genotype hypothesis" [18]. This theory states that in ethnicities that may have been exposed to periods of famine, a particular gene was often better suited and often chosen. This gene may have given individuals an advantage in metabolizing energy to its maximum capability. However, this gene is not good in times of over-abundance of food, which often comes with industrialization and urbanization[18]. This "thrifty gene" hypothesis may be the reason that Japanese, Chinese and Asian Indians are more susceptible to NIDDM at a lower BMI.

Based on the observations that Japanese Asians often have lower a BMI correlating with the risk of NIDDM occurrence, scientists theorized that the Japanese may have weaker beta cells. These are the insulin-producing cells in the pancreas [12]. This theory may be applicable to other Asian populations as well as the ones mentioned earlier in this paper. A relative defect in insulin secretion in Asians may account for the lower obesity often seen with NIDDM prevalence when compared to Caucasian population [12]. Abdominal fat, or central obesity is more common in Asians and plays a role in the increased prevalence of NIDDM. This theory if accurate, maybe key in targeting NIDDM in Asians because changes in diet and physical exercise can often target abdominal fat. Public health studies can use this information as a tool in decreasing NIDDM prevalence in Asians. This review of diabetes-related studies among Asians suggests a rising prevalence of NIDDM. Further research into risk factors and public health interventions should be targeted towards these populations.

TABLE 1. WHO classification criteria used after a 75-g glucose tolerance test [13].

<u>World Health Organization</u>	
Normal Glucose Tolerance (NGT):	Fasting plasma glucose < 115 mg/dl
	2 Hour plasma glucose < 140 mg/dl
Impaired Glucose Tolerance (IGT):	Fasting plasma glucose < 140 mg/dl
	2 Hour plasma glucose ≥ 140 mg/dl
Diabetic (NIDDM):	Fasting plasma glucose ≥ 140 mg/dl
	2 Hour plasma glucose ≥ 200 mg/dl

TABLE 2. Estimated number and prevalence of adults with NIDDM in the top ten countries with the highest number [15].

{PRIVATE}Country	1997 (in millions)	Prevalence Percent	2025 (in millions)	Prevalence Percent
India	20,789	3.8%	57,243	6.0%
China	17,064	2.0%	37,555	3.4%
US	14,315	7.4%	21,892	8.9%
Russian Federation	9,168	8.4%	12,240	11.4%
Japan	6,523	6.5%	8,543	8.7%
Brazil	5,254	5.2%	11,603	7.2%
Indonesia	4,886	4.1%	12,427	6.5%
Pakistan	4,727	6.7%	14,523	8.7%
Mexico	4,170	7.1%	11,684	12.3%
Egypt	3,464	9.9%	8,802	13.3%

TABLE 3. This NIDDM prevalence data is the collection of data from the articles referenced in this paper. These are estimates of the NIDDM prevalence in these sub-populations because each article used different collection criteria. There does not seem to be significant differences in prevalence of NIDDM between the various countries of migration.

Ethnicity	Native Rural Population	Native Urban Population	Migrant Population
Asian Indian	2%	9-11%	16-20%
Japanese	4-5%	3-4%	8-10%
Chinese	0.3%-1%	6%	12.5-15%

TABLE 4. Summary of articles discussed in text. Reference numbers refer to the number assigned to each particular article in the review.

Study	Type of Study	Ref. No.	Location	Year	Population Size and Description	Results
Banerji et al	Clinical Trial	1	New York, US	1998	20 Asian Indian Males	NIDDM Prevalence 2%-Rural India; 11%-Urban India; 16%-Migrant Asian Indian population; WHO criteria followed
Ramchandran et al	Cross-sectional	2	Madras, South India	1997	2183 Asian Indian Men and Women	NIDDM Prevalence was compared to results of another study (Ref.No.3) Raised to 11.6% in urban population; WHO criteria followed
Ramchandran et al	Cross-sectional	3	Madras, South India	1992	1038 Asian Indian Men and Women	NIDDM Prevalence 8.2%-Urban India; 2.4%-Rural India; WHO criteria followed
Omar et al.	Cross-sectional	5	Durban, South Africa	1994	2479 Asian Indian Men and Women	NIDDM Prevalence 9.8%-S. African Asian Indian; WHO criteria followed
McKeigue et al	Cross-sectional	6	London, United Kingdom	1992	3473 South Asian and European Men and Women	NIDDM Prevalence 9.6%-South Asian; 7.1%-European; WHO criteria followed
McKeigue et al	Cross-sectional	7	London, United Kingdom	1991	3754 South Asian and European Men and Women	NIDDM Prevalence 19%-South Asian; 4%-European; WHO criteria followed
Kitazawa et al	Cross-sectional	8	Tokyo, Japan	1983	5178 urban Japanese Men and Women	NIDDM Prevalence 3.6%-Urban Japan; WHO criteria followed
Takashima et al	Cross-sectional	9	Rural Japan	1983	3145 rural Japanese Men and Women	NIDDM Prevalence 3.9%-Rural Japan; WHO criteria followed
Huang et al	Prospective	10	Hawaii and California, US; Japan	1996	8006 Japanese-American Men	NIDDM Prevalence increased as there was an increased acculturation for Japanese lifestyle; Alternative study-specified criteria followed
Burchiel et al	Prospective	11	Hawaii and California, US; Japan	1995	6815 Japanese-American Men	NIDDM Prevalence increased as amount of physical activity

						decreased; Alternative study-specified criteria followed
Fujimoto et al	Cross-sectional	12	Washington State, US	1987	229 Second generation Japanese American Men	Retinopathy, neuropathy, nephropathy, hypertension and ischemic heart disease prevalence were all increased with NIDDM WHO criteria followed
Fujimoto et al	Cross-sectional	13	Washington State, US	1987	229 Second generation Japanese American Men	NIDDM Prevalence 11.1% of Second generation Japanese American Men; WHO criteria followed
Sloan	Cross-sectional	19	Oahu Hawaii, US	1963	38,103 Chinese, Japanese, Korean, Filipino, and Caucasian Men and Women	NIDDM prevalence 14.6%-Chinese; 20.1% -Japanese; 19.7-Korean; 21.8%-Filipino; 7.3 %-Caucasian. Alternate criteria followed
Boyko et al.	Prospective	20	Washington State, US	2000	290 Second generation and 230 Third generation Men and Women	There was an increased NIDDM prevalence with increased visceral adiposity and BMI

References

1. Banerji MA, Faridi N, Atluri R, Chaiken R, Lebovitz H. Body composition, visceral fat, leptin, and insulin resistance in Asian Indian men. Journal of Clincal Endocrinology and Metabolism.1999; 84: 137-144.

2. Ramchandran A, Snehalatha C, Latha E, Vijay V, Viswanathan M. Rising Prevalence of NIDDM in an urban population in India. Diabetologia.1997; 40: 232-237.

3. Ramchandran A, Snehalatha C, Dharmaraj D, Viswanathan M. Prevalence of glucose intolerance in Asian Indians. Diabetes Care. 1992; 15: 1348-1355.

4. Laws A, Jeppesen JL, Maheux PC, Schaaf P, Chen YD, Reaven GM. Resistance to insulin-stimulated glucose uptake and dyslipidemia in Asian Indians. Arteriosclerosis and Thrombosis. 1994; 14: 917-922.

5. Omar MAK, Seedat MA, Dyer RB, Motala AA, Knight LT, Becker PJ. South African Indians show a high prevalence of NIDDM and bimodality in plasma glucose distribution patterns. Diabetes Care. 1994; 17: 70-73.

6. McKeigue PM, Pierpoint T, Ferrie JE, Marmot MG. Relationship of glucose intolerance and hyperinsulinemia to body fat pattern in South Asians and Europeans. Diabetologia. 1992; 35: 785-791.

7. McKeigue PM, Shah B, Marmot MG. Relation of central obesity and insulin resistance with high diabetes prevalence and cardiovascular risk in South Asians. Lancet. 1991; 337: 382-386.

8. Kitazawa Y, Murakami K, Goto Y, Hamazaki S. Prevalence of Diabetes Mellitus detected by 75 g GTT in Tokyo. Toboku Journal of Experimental Medicine. 1983; 141: 229-241.

9. Nakamura N, Ichinose K, Furushima H, Uzawa H. Studies on 75 g oral glucose in the inhabitants of Kumamoto Prefecture, Japan. Toboku Journal of Experimental Medicine. 1983; 141: 243-250.

10. Huang B, Rodriguez BL, Burchfiel CM, Chyou PH, Curb JD, Yano K. Acculturation and prevalence of diabetes among Japanese-American men in Hawaii. American Journal of Epidemiology. 1996; 144: 674-681.

11. Burchfiel CM, Sharp DS, Curb JD, Rodriguez BL, Hwang L, Marcus EB, Yano K. Physical Activity and Incidence of Diabetes: The Honolulu Heart Program. American Journal of Epidemiology. 1995; 141: 360-368.

12. Fujimoto WY, Leonetti DL, Kinyoun JL, Shuman WP, Stolov WC, Wahl PW. Prevalence of complications among second-generation Japanese-American men with diabetes, impaired glucose tolerance, or normal glucose tolerance. Diabetes. 1987; 36: 730-739.

13. Fujimoto WY, Leonetti DL, Kinyoun JL, Newell-Morris L, Shuman WP, Stolov WC, Wahl PW. Prevalence of diabetes mellitus and impaired glucose tolerance among second-generation Japanese-American men. Diabetes. 1987; 36: 721-729.

14. U.S. Department of Health and Human Services. Physical Activity and Health: A Report of the Surgeon General. Atlanta, GA: U.S. Department of Health and Human Services, Centers for

Disease Control and Prevention, National Center for Chronic Disease Prevention and Health Promotion, 1996.

15. Report of the Expert Committee on the Diagnosis and Classification of Diabetes Mellitus. Diabetes Care 1997; 20(7):1183-97.

16. Tseng CH, Chong CK, Heng LT, Tseng CP, Tai TY. The incidence of type 2 diabetes mellitus in Taiwan. Diabetes Research and Clinical Practice. 2000; 50 Suppl 2: S61-4.

17. Cockram CS. The epidemiology of diabetes mellitus in the Asia-Pacific region. Hong Kong Medical Journal. 2000; 6: 43-52.

18. Fujimoto WY. Diabetes in Asian Americans. In Diabetes in America, Second Edition. Diabetes Data Compiled. Bethesda, MD, Chap.33, 661-680.

19. Sloan NR. Ethnic distribution of diabetes mellitus in Hawaii. JAMA. 1963; 183:419-23.

20. Boyko EJ, Leonetti DL, Fujimoto WY, Newell-Morris L. Visceral Adiposity and Risk of Type 2 Diabetes. Diabetes Care. 2000; 23: 465-471.

21. Acanthosis Nigricans. UTMB General Clinical Research Center. July 20, 2001. Available: http://www2.utmb.edu/gcrc/INCLUDE/In%20the%20news/DirtyNeck/acanthosis_nigricans.asp

22. Bureau of the Census: The Census Population: 2000. Washington, DC, U.S. Government Printing Office. Online. Internet. 19 July, 2001. Available: http://www.census.gov/Press-Release/www/2001/tables/dp_us_2000.PDF.

APPENDIX A

CRITERIA FOR SUBMISSION TO JOURNAL OF ETHNICITY AND DISEASE

{PRIVATE}*Ethnicity & Disease* Contributor Guidelines

Ethnicity & Disease invites original contributions devoted to the study of population differences in disease patterns. Work examining the interaction of biologic, social and economic factors as they affect disease rates is of particular interest to our readers. We strongly encourage authors to address the issues that surround and complicate ethnic distinctions rather than to merely employ ethnic and racial terms with their attendant stereotypes.

Manuscripts considered for publication have not been previously published nor submitted elsewhere for publication. All manuscripts are refereed by the *Ethnicity & Disease* editorial board and review committee. Authors receive comment from the editorial board, are requested to make changes as recommended and return the manuscript on hard copy as well as on computer disk, using a common word-processing software package. Additional instructions on disk preparation are provided with review comments.

Copyright Transfer

It is a condition of acceptance that the papers become the copyright of the publisher; authors will be asked to transfer copyright of accepted manuscripts to the journal.

Manuscripts - Submittal Requirements

Cover Letter

All manuscripts should be submitted with a cover letter that identifies the individual responsible for correspondence with the editors. Provide an exact postal address and telephone and fax numbers. The letter should mention any related work currently under review. Authors must document that all persons acknowledged in the manuscript have seen and approved the mention of their name in the paper.

Submittal Options

Authors may submit manuscripts to *Ethnicity & Disease* in two ways:

1) Mail four copies of the manuscript, including all tables and figures, a cover letter, and electronic file to:
Keith C. Norris, MD
Editor-in-Chief
Ethnicity & Disease
2045 Manchester St, NE
Atlanta, Georgia 30324

2) Submit an electronic file online - click here; mail one hard copy to *Ethnicity & Disease* at the address above.

Format

Authors must supply three copies of the manuscript, including all figures and tables. Text should be typed, double-spaced, on white bond paper. Margins should be not less than 1 inch or 3 cm. Number all pages, beginning with the title page. Abbreviations should be kept to a minimum; consult the *American Medical Association Manual of Style*, 9th Edition, for information on the use of abbreviations. SI units must be used, with a few standard exceptions (eg, for blood pressure). Submit copies of any closely related work currently in press, along with the manuscript to be considered.

Presentation of Papers

Title page (page 1)

The title page should include a specific, concise main title, and the first, middle initial and last name of each author, academic degrees and affiliations of all authors, and specific contact information for the corresponding author.

Key Words: An alphabetical list of 3-10 key words or short phrases conforming to the Medical Subject Headings in Index Medicus is encouraged.

Acknowledgments: Acknowledge all sources of support for research. Acknowledgments should be made only to those who have made a substantial contribution to the study. Authors are responsible for obtaining written permission from people acknowledged by name in case readers infer their endorsement of data and conclusions.

Running head: A "running head," or short title, to be used as the header on pages of the journal carrying the paper, should be listed on the title page and should be no more than 40 characters, including spaces.

Disclaimer: Any disclaimers should appear on the title page, as should the name and address of the author responsible for correspondence concerning the manuscript, and the name and address of the author to whom requests for reprints should be made. If reprints are not to be made available, a statement to this effect should be included.

Abstract (page 2)

A single-paragraph abstract of approximately 200 words should provide a factual statement of purpose of the study, the methods used, the principal findings and conclusions. The abstract should follow the title page. Follow these formats, as identified by the International Committee of Medical Journal Editors.

(a) Articles containing original data concerning the course, cause, diagnosis, treatment, prevention or economic analysis of a clinical disorder or an intervention to improve the quality of health care should include a structured abstract with the following headings and information: objective, design, setting, patients/participants, interventions, main outcome measure(s), results, conclusions.

(b) Articles concerning original experimental research should include a structured abstract with the following headings and information: objectives, design, methods, results, conclusions.

(c) Review articles should include an abstract which, if appropriate, may be structured with the following headings: purpose, data identification, study selection, data extraction, results of data analysis, conclusions.

Text (pages 3 on)

Introduction: Authors should provide a concise description of the reason for the study as well as a brief summary of the background to assist the general reader.

Methods: The interdisciplinary nature of the journal requires a moderately detailed description of the methods used, especially when methods are new or unusual. State any assumptions on which methods are based. Clearly describe the statistical methods used.

Results: Clearly state and systematically describe results, mentioning or highlighting, but not duplicating, information displayed in the tables.

Discussion: Use this section as an interpretation of your results and statements of conclusions. Opinions and speculation should be clearly identified. Provide arguments against, as well as in support, of your conclusions. Where your results conflict with previously published work, provide possible explanations.

References

References should be cited in the text using superscript numbers and should be numbered consecutively in the order in which they first appear in the text. They should be assigned Arabic numerals and listed after the text. Consult the *American Medical Association Manual of Style* for reference style. Two examples follow:

Example 1 (journal): Peterson HR, Rothschild M, Weinberg CR, Fell RD, McLeish KR, Pfeifer MA. Body fat and the activity of the autonomic nervous system. *N Engl J Med.* 1988;318:1077-1083.

Example 2 (book):
Kavet J. Trends in the utilization of influenza vaccine: an examination of the implementation of public policy in the United States. In: Selby P, ed. Influenza: Virus, Vaccines,and Strategy. Orlando, Fla: Academic Press Inc; 1976:297-308.

Tables

Each table should be typed on a separate page and should be numbered (eg Table 2) in the order in which they are mentioned in the text. Give each table a brief title. Tables should not be submitted as photographs. Vertical rules should not be used.

Illustrations, Figures

Submit two complete sets of camera-ready prints of each illustration. Paste a label on each print to identify the figure number, the title of the paper, the author's name and a mark indicating the top of the figure. Legends should be included on the illustration.

Direct correspondence to:

Keith C. Norris, MD
Ethnicity & Disease
2045 Manchester St, NE
Atlanta, Georgia 30324
404.875.6263
404.875.6334 (f) or ethndis@ishib.org