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Diabetes in the U.S. Asian-Indian Population: Finding Answers in Diet and Lifestyle

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Diabetes in the U.S. Asian-Indian Population: Finding Answers in Diet and Lifestyle

Disciplines
Anthropology

**Diabetes in the U.S. Asian-Indian population: Finding Answers in Diet
and Lifestyle**

A Senior Thesis in Anthropology

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May 3, 2006

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Abstract

The number of diabetics in the United States has grown considerably each year. A significant proportion of these diabetics are of Asian Indian ethnicity, as their genetic predisposition places them at greater risk of developing diabetes. Although a rapidly growing ethnic population in the U.S. and with a high incidence rate of diabetes, research regarding diabetes in this population is only slowly emerging. Since the Asian Indian population has a common predisposition for diabetes, it was hypothesized that the risk of developing the disease primarily depended on diet. In order to determine whether the diet of Asian-Indians contained diabetes-promoting foods as well as their knowledge and concern for diabetes, a small population of Malayalee Indians was surveyed. Analysis of the data collected revealed the observance of three different diets, each arising from a combination of factors. As diabetes is heavily reliant on behavior modification, diet and lifestyle interventions are argued as the primary means to prevent the rise of diabetes to epidemic proportions in the Asian Indian population.

Introduction

In 1995, the U.S. ranked third following India and China for the number of adults with diabetes. Estimates from 1998 projected the same third place standing for the U.S. in the year 2025 with nearly 21.9 million adult diabetics (King, 1998:1417). The American Association of Physicians of Indian Origin indicated that nearly 2,200 people in the U.S. are diagnosed with diabetes each day (AAPI, 2001). Those of Asian Indian ancestry are undoubtedly well represented in the number considering the 1.9 million Asian Indians living in the United States, and the well-acknowledged prevalence of diabetes within the group (Venkataraman, 2004:977). Research of diabetes within the Asian-Indian population has already indicated a predisposition toward diabetes. Significant increase or decrease in the risk of developing diabetes, therefore, rests in factors of diet and lifestyle choices. Many researchers have suggested particular foods as contributing to the risk of diabetes. Are Asian-Indians actually consuming large quantities of such foods? If Asian-Indians are at such high risk of developing diabetes, how many are knowledgeable and concerned about the disease? These questions were examined in greater detail through a study conducted of a small population of Malayalee Indians (a subset of the Asian-Indian population). The study although limited in scope was an attempt to address the above questions and assess the need and avenues for education and prevention in the population. Early intervention in the factors of diet and lifestyle may provide the control necessary of a disease otherwise growing to epidemic proportions in the population.

Background on Type II Diabetes

Between the two most common types of diabetes, type II accounts for nearly 95% of all cases (Dean, 2004:3). Individuals with type II diabetes fail to either produce enough insulin to

regulate the level of glucose (sugar) in their blood or fail to respond properly to the insulin. Therefore, they are characterized by having unusually high blood sugar levels (3).

No one particular factor contributes to the development of diabetes in an individual. In most cases, it is triggered by a combination of genetic and environmental factors. Nevertheless, type II diabetes appears to be more strongly linked to genetics than type I. Once genetically predisposed to diabetes, an individual's risk of developing the disease heightens if the individual leads a Western lifestyle (The Genetics of Diabetes, 2005). The diet, which accompanies a Western lifestyle, often increases the individual's chance of becoming obese. This correlation is of particular importance because obesity has been repeatedly identified as a major risk factor for diabetes.

Although, diabetes is quite manageable, it must be taken very seriously because of its close ties to other life-threatening illnesses. Endocrinologist Lt. Col. MK Grag, speaking at a seminar on "Diabetes and its awareness," acknowledged that diabetes can reduce life expectancy by five to seven years if left untreated. He also asserted that living with diabetes increases the risk of heart disease by 50 times, renal complications by 17 times, and gangrene by 25 times (The Times of India, 2004).

According to projections made in a World Health Organization publication in 1998, an increase of 42% in the number of people with diabetes was expected between 1995 and 2025 for the developed nations.

Diabetes and the Role of Genetics

Research has revealed that the onset of diabetes involves several factors. Currently, much of the focus has revolved around genetic and environmental cues. It is with a genetic

predisposition to the disease, particular in the case of type II diabetes, that many individuals become more prone to the development of diabetes (The Genetics of Diabetes, 2005). Although researchers have determined that type II diabetes involves many genes, identifying these genes has proven more difficult. Much of the reason lies in the possibility that these “diabetes genes” could simply be small variations of a particular gene sequence. Such variations are too abundant within the population to indicate an association between a particular gene and an increased risk of diabetes. Nevertheless, in the hopes of finding “diabetes genes” researchers have conducted genome linkage studies, in which “the entire genome of affected family members are scanned, and [thereafter]... followed over several generations” (Dean, 2004:3). Their efforts have revealed two “diabetes susceptibility genes,” calpain 10 (CAPN 10) and hepatocyte nuclear factor 4 alpha (HNF4A) that influence the risk of developing diabetes (Dean, 2004:3).

Current estimates of the number of people living with diabetes suggest that the disease has reached near epidemic proportions. According to one theory, “thrifty genes” may have a central role in the rising prevalence of the disease. These genes are especially important to the survival of an individual when living in an environment prone to famines and starvation. When food is available under these conditions, “thrifty genes” allow the individual to utilize the food to build up “fat stores.” These “fat stores” provide the energy necessary to survive the food shortages prevalent during famines. Unfortunately, when food is available in constant supply, these genes become disadvantageous to the survival of the individual. Continuing to build up “fat stores” under this constant supply of food, these “thrifty genes” contribute to threat of obesity. Considering the intimate relationship between obesity and diabetes, “thrifty genes” may be yet another set of genes crucial to the development of diabetes (Dean, 2004:9, Lieberman, 2003:356).

As illustrated by the case of the “thrifty genes,” genetic and environmental factors are closely intertwined. Therefore, genetic predisposition alone does not determine an individual’s risk for diabetes. In fact, this predisposition to diabetes only seems to be a significant factor when the individual follows a Westernized lifestyle. In regions around the world untouched by Western standards, the threat of type II diabetes remains significantly lower regardless of the population’s level of predisposition toward the disease (The Genetics of Diabetes, 2005). Further proof for this notion of diabetes as having more than a genetic component lies in studies conducted with identical twins. If one twin is diagnosed with type II diabetes, the other twin has at most a 3 in 4 chance of developing type II diabetes. Although they are genetically identical, their likelihood of developing diabetes may vary as a consequence of environmental differences (The Genetics of Diabetes, 2005).

Diabetes and the Role of Diet and Lifestyle

In association with an individual’s genetic makeup, the environmental cue most significant in the risk of diabetes is the lifestyle led by the individual. Before the onset of diabetes, most individuals as a consequence of their genetic makeup become insulin resistant. According to experts, this resistance is heightened if the individual grows obese and leads an inactive lifestyle (Patlak, 2002). With the modernization and globalization occurring throughout the world obesity and a sedentary lifestyle have become the trend. Many fast food franchises have expanded and become more widely available for mass consumption. Unfortunately, much of the fast foods available contain large amounts of hydrogenated oils, which as fatty acids work to actually “hamper the action of insulin in muscle cells” (Patlak, 2002, Pereira et al., 2005:41). Fast foods also contain “highly refined starchy food and added sugar,” which along with high-fat

dairy products and red meat are part of a “diabetes-boosting diet” (Patlak, 2002, Pereira et al., 2005:41). In addition to the increased intake of such foods, modernization has worked to decrease the level of energy output with the contribution of motor vehicles and public transportation (Lieberman, 2003:360). The fallen levels of energy expenditure in combination with a greater consumption of high-caloric foods have led to the increased prevalence of obesity around the world. Considering that more than 75% of diabetics are obese, this factor cannot be dismissed (Patlak, 2002). However, in the case of diabetes, simply examining the extent of obesity within an individual proves insufficient. It becomes imperative to consider how the fat is distributed within each person. It appears that an increased distribution of fat in the abdominal region increases the risk of developing diabetes (Fact Sheet, 2003, Abate et al., 2001:322). In contrast to the fat found elsewhere in the body, the visceral fat within the area “secretes far more hormones and other circulating substances that counter the effects of insulin at the cellular level” (Patlak, 2002). Recent research has shown that the subcutaneous fat in the area also plays a role in insulin resistance (Ramachandran et al., 2002:1473). As a consequence of these deposits, the individual grows more insulin resistant and in turn more likely to develop diabetes. The rise of obesity along with a sedentary lifestyle characteristic of Western practices, therefore, contributes to an increase in insulin resistance more so than directly causing diabetes.

Further evidence for insulin resistance in the population comes from a study conducted using American and Asian Indian vegetarians. Examination of their insulin and glucose levels, revealed that the Asian Indian men involved always had higher levels of insulin present than their American counterparts. Further analysis disclosed that with fewer binding sites for insulin on their red blood cells, the percent of insulin binding was significantly less than in the case of the American subjects. With this “decreased affinity” for the insulin present in the blood, the

insulin begins to accumulate (Scholfield et al., 1987:957). Considering this, a greater amount of insulin would be required to regulate the glucose levels. Many have suggested that the decreased binding of the insulin may have resulted as a consequence of genetic factors (Scholfield et al., 1987:959). However, the author is quick to point out that changes in the type of carbohydrates consumed within the diet can also adversely affect insulin resistance.

Indians also appear to have a predisposition to certain physical characteristics. Studies conducted in the northern and southern regions of India demonstrate a higher percentage of body fat in Indians. Although those participating in the studies had ideal body mass index (BMI) values, their levels of body fat percentage were similar to that of the *overweight* white subjects within the study (Ramachandran et al., 2004:193). Moreover, their bodies have a predisposition toward the accumulation of abdominal fat (Ramachandran et al., 2004:28). As discussed before, increased deposits of fat in the abdominal region has a significant link to the risk of developing diabetes. With such deposits of fat in the abdominal area, Indians for a given BMI, appear to have greater central adiposity (Ramachandran et al., 2004:192). Although considered to have ideal BMI levels, such genetic predispositions under the influence of a Western lifestyle have heightened their resistance to insulin.

With increased levels of insulin resistance, the number of Indians falling to the threat of diabetes continues to grow. Throughout India, modernization has resulted in varying prevalence of diabetes among urban and rural populations. Dr. Garg, an endocrinologist speaking at a seminar on "Diabetes and its Awareness," reported that nearly 70% of diabetics within India reside in urban areas, while only 30% inhabit rural regions. He suggested that the "lifestyle and food habits in the city" are to blame for the trend (The Times of India, 2004). With the increased urbanization in India, traditional lifestyles have given way to modern practices in urban centers

throughout the country. In regards to diet, affluence and modernization within urban regions has resulted in the consumption of more fats and more calories by means of refined cereals and carbohydrates within their diets (Mohan, 2004: 471, Ramachandran et al., 2002:1473).

Urbanization has also led to an overall decrease in the physical activity for many Indian urbanites. Technological advancements arising from modernization have provided “energy saving methods of transport and labour,” leaving Indians with very little reason to engage in vigorous physical activities (Ramachandran et al., 2002:1474). This experience of urbanization in India and its apparent heightening of the risk of diabetes prove similar to the effects seen in people immigrating and becoming integrated to modern lifestyles of the U.S (Venkataraman, 2004:979).

Regional Contributions to the Prevalence of Diabetes

Despite immigration, regional patterns of cuisine remain evident in the consumption patterns of Asian-Indians (Jonnalagadda, 2002:1286). This in turn can result in variations in the individual's risk of developing diabetes. Some effort to understand these regional differences resulted from the National Urban Diabetes Study. According to the study the southern parts of India-- Chennai with 13.5%, 12.4% in Bangalore, and 16.9% in Hyderabad, appear to have the highest incidence of diabetes (Mohan, 2004:468). The eastern, northern, and western regions in comparison show prevalence rates of 11.7%, 11.6%, and 9.3% respectively (469). This higher frequency of diabetes in southern India, particularly in the southwestern state of Kerala, may reflect the cuisine of the region. Recent estimates, after accounting for the possible bias toward higher prevalence resulting from the impressive detection rates in Kerala, identify nearly 11% over the age of 20 with type II diabetes (The Hindu, 2002). In general, the Indian diet is “rich in

carbohydrates with almost an equal distribution of proteins and fats” (Shobana et al., 1998:182). The South Indian meal when considered alongside meals of other regions of India contains the highest amount of fat. It is well acknowledged that “fat makes an important contribution to energy intakes.” In the case of Kerala, nearly 22% of the energy is obtained from various sources of fat (Nigam, 2000:61). If an individual’s energy intake exceeds the recommended level as a result of increased fat consumption, obesity may very well pose a threat. According to a report in the Hindu Times, 35% of those over the age of 35 in Kerala are overweight (The Hindu, 2002). Considering the close ties between obesity and diabetes, the high amounts of fat in the South Indian meal is of great significance. Research of the fat intake throughout India has revealed that Kerala consumes the highest amount of “invisible fat,” nearly 50.5g through cereals (largely rice and tapioca), pulses, eggs, meat, and vegetables available in its South Indian cuisine (Nigam, 2000:59-61). The diet also consists of large quantities of coconut and coconut oil. Nearly 88% of the oil contains saturated fatty acids, which contributes a significant amount of “visible fat” to the individual’s total energy intake (Nigam, 2000:60). An inactive lifestyle in combination with such a diet only heightens the risk of diabetes for a population already predisposed to the illness.

Type II Diabetes in the U.S. Asian-Indian Population

With immigration to the United States, Asian-Indian families attempt to integrate the regional diets of their native lands and the foods of American culture. The acculturation has not necessarily improved health in regards to diabetes for immigrant Asian-Indians when compared to their counterparts in India. In fact, a study conducted by Venkataraman et al. revealed similar rates of prevalence of diabetes in their study population in the U.S. and those reported for urban India. Within the U.S. itself, the prevalence of diabetes in Asian-Indians is markedly higher than

that of other minority groups. Venkataraman et al. reported that those older than 20 years of age in their study had a prevalence of diabetes twice that of Hispanics (9.3%) and nearly four times that of whites (4.8%) (Venkataraman et al., 2004:979). Although Asian-Indians between the age of 60-74 had a prevalence rate (24.8%) comparable to that of Hispanics (24.4%), it was nevertheless much higher than that found in whites of the same age group (11.3%) (979). Among their study population of Gujaratis living in the Atlanta region, the prevalence rate appeared to increase progressively between the age of 40 and 70 (Venkataraman et al., 2004: Fig.1)

In regards to physical health, the link between obesity and diabetes suggests higher rates of diabetes in populations with higher body mass indices. However, Asian-Indians continue to have a greater prevalence of diabetes in comparison to non-Hispanic whites despite having lower BMI values (Mohanty et al. 2005:477). Experts express that although BMI values are suitable measures of obesity, they do not provide accurate information in regards to insulin resistance and in turn the risk of diabetes for the Asian-Indian population. In comparison to whites, Asian-Indians develop truncal obesity to a greater degree. For this reason, many argue that measures of truncal obesity provided through waist-hip ratios are a better means of diagnosis for this particular group. Some experts have gone even further and suggested that perhaps all Asian-Indians should be considered "pre-diabetic" (477). Although this suggestion may seem extreme, Asian Indians have a very low sensitivity to insulin for relatively low BMI values. Therefore, a small increase in weight may reduce insulin sensitivity to a point at which diabetes develops (Ramachandran, 2003:17).

The epidemic nature of diabetes in the Asian Indian population has only heightened because of the sedentary lives led by most immigrant South Asians. Concerned with establishing successful lives for themselves and their families, most South Asians do not find the time to

exercise (Sridaran, 1994:47). In fact, in a survey conducted of 237 South Asians originating from different regions of Indian, 38% reported never engaging in any form of physical activity (Jonnalagadda, 2002: 1288). Moreover, with automobiles seen as a necessity in the U.S., nearly everyone has a car. Many Asian Indians, therefore, are participating in very little rigorous activity in traveling from one place to another. In India, on the other hand, people find themselves walking or using a bicycle to move about, resulting in some degree of physical activity daily (Sridaran, 1994:47).

In addition to inactivity, the changes in diet for many immigrant South Asians has meant an increased risk of obesity and in turn an increased potential to develop diabetes. According to Sridaran and Kolhatkar, many Asian Indian immigrants began to incorporate fast foods and other “high-calorie, high-fat foods” into their diet in the process of acculturation (Sridaran, 1994:47). Sandwiches, soups, and meats are being consumed in greater quantities and appear to have become staples for Asian Indians. Similarly, in the diets of many Asian Indians, American breads have substituted the wheat flatbreads once so common to the Indian diet (47). Kulkarni, in his survey of a group of South Asians in the U.S., concluded that with immigration this group has essentially abandoned their low fat, high fiber diets and adopted one with greater quantities of animal protein, saturated fats, and low fiber (Kulkarni, 2004:191). Several studies have demonstrated that a diet rich in saturated fats decreases the body’s sensitivity to insulin, while the risk of diabetes is reduced if a diet rich in fiber is consumed (Bazzano, 2005:311-312). For immigrant Asian Indians, the combination of a diet rich in saturated fats and low in fiber would potentially increase their risk of developing diabetes. Additional studies have displayed an increased risk of developing diabetes with consumption of foods that heighten an individual’s glycemic load (312). Since the carbohydrate content of foods determines glycemic loads, this

finding is of particular importance as Asian Indian immigrants derive nearly 60% of their daily energy intake from carbohydrates (Misra, 2004:485).

As an immigrant population, the duration of time in the U.S. significantly affects the composition of the diets of Asian Indians. With increased length of time spent in the U.S., Asian Indians digress from traditional Indian cuisine and begin to consume a greater proportion of non-ethnic foods and alcoholic beverages (Diwan, 2001:50). In the process of assimilation, Asian Indians are seen consuming increased amounts of American meals as well as chips, fruit juices, colas, alcohol, fruit, and margarine, and other Western baked goods (Sudha, 1999:1108; Kulharni, 2004:191). Although, over time they have abandoned the use of saturated fats such as ghee (clarified butter) and butter in cooking, their total energy intake and the proportion of energy derived from fats has increased upon immigration to the United States (Kulharni, 2004:191; Jonnalagadda, 2002:1287). In a study conducted of various groups of Asian immigrants, including Asian Indians, the likelihood of becoming overweight increased with duration in the United States (Lauderdale, 2000:1192). Moreover, analysis of the National Health Interview Survey from 1992 to 1995 revealed that with increased time spent in the U.S., Asian Indians experienced a general deterioration in health (Mohanty, 2005:474). These results are precisely due to the unhealthy diets and inactive lifestyle arising from acculturation into an unfamiliar culture.

Survey Data Analysis

With a relatively higher prevalence of diabetes in Asian Indians comparable to other immigrant populations in the U.S., the need for education and targeted prevention in this group intensifies. Considering the association between diet/lifestyle and diabetes, a survey was

conducted among a small population of South Indians in an attempt to understand their dietary habits as well as their concern and knowledge of diabetes. The survey and the dietary recall requested provided the opportunity to examine if South Indians were consuming foods that could potentially increase their risk of developing diabetes. Perhaps, more importantly, the data collected produced some insight into how to best target education to alleviate the impact of diabetes for Asian-Indians.

Methods

The survey carried out to address these questions was in the form of a questionnaire. In addition to some demographic information, it asked the individuals to record a dietary recall. Participants were instructed to record the dietary recall between Monday and Friday in an attempt to minimize the fluctuations that occur during the weekend. The questionnaire also asked several questions regarding the individual's concern and knowledge of diabetes. Nearly 85 forms were given out to a group of South Indians at St. Mary's Cathedral upon conclusion of services. The initial group was permitted a week to complete the form and return it the following Sunday. With a lack of response the initial week, phone calls were made to members' houses on Saturday evenings as a reminder. After two weeks, an additional 15 forms with attached envelopes were given to more members in order to gather a sufficient amount of data. Several more questionnaires were given to other Malayalee South Indians belonging to other churches. At the conclusion of the study, 108 questionnaires were given to this target population, of which 51 were returned and used in the analysis that follows.

The Population

Table 1 **Study Population**

Age Range	Males	Females	Missing	Total
10-19	3	2	0	5
20-29	2	10	0	12
30-39	2	4	1	7
40-49	2	3	0	5
50-59	2	4	0	6
60-69	2	1	2	5
Missing	6	2	3	11
Total	19	26	6	51

The survey population consisted of 51 South Indians of whom 69% were born in India, 20% in the United States, 4% in the United Arab Emirates, and the remainder of unknown origin. Regardless of their place of birth, all of the participants belong to an ancestry that originates in India. More specifically, these individuals are presumed to have families arising from the state of Kerala. One of the states on the southern most tip of India, Kerala primarily consists of Hindus, Muslims, and Christians (India Heritage). Keralite Christians predominately consume a non-vegetarian diet. It was presumed that all the participants in the survey were also non-vegetarians as all of them were Christians. In fact, a majority of the individuals belongs to a single congregation while a few others attend other churches in the Philadelphia region.

Among the 51 participants, 26 females, 19 males, and 6 individuals of unreported gender are represented (Table 1). The average age within the population is 35.6 years, with the majority of immigrant women and men arriving in the United States at 23.3 and 28.1 years respectively.

Observations

Review of the dietary recalls revealed three different diets consisting of American and Indian cuisine. The first included primarily Indian foods (two or more Indian meals in a given day), the second a combination of American and Indian foods (one Indian meal), and the third largely American foods (zero Indian meals). Those consuming an Indian diet reported as eating two or more Indian meals during the course of the day. From one individual to the next, the contents of these two meals remained consistent. One meal generally contained some rice with curried vegetables, yogurt salad dressing, and curried meat or fish. The second meal often consisted of store-bought or homemade chapattis (wheat flat bread) with curried vegetables, meat, or yogurt salad dressing. To illustrate, an individual classified as eating an Indian diet recorded as consuming the following for lunch: 2 cups of rice with two tbsps. of beans with coconut, 2 tbsps. of yogurt made with Indian spices, 2 pieces of fish curry, 16 ounces of water, and 1 apple. In addition, the individual ate the following for dinner: four chapattis prepared with wheat flour and 1 tsp. of vegetable oil, chicken curry, and 16 ounces of water. The individuals who consumed a combination of American and Indian foods typically only ate one Indian meal during the reported day. The Indian meal usually consisted of either rice or chapattis with vegetables and/or a meat dish. Interestingly, 73% of the individuals ate rice as their Indian meal, while only 20% ate chapattis and 6.6% consumed both during the one meal. The American portion of their meals included soups, salads, sandwiches, and meat dishes. An individual from this group reported as having one tuna sandwich with mayonnaise, lettuce, and tomatoes or rye bread, 16 ounces of diet ice tea, and one medium apple for lunch. For dinner, the individual consumed a typical Indian meal consisting of two cups of rice, half a cup of string beans, two tbsps. of yogurt, one tsp. of pickle, four ounces of fish, and two cups of water. Unlike this

individual, those eating an American diet did not consume any Indian meals during the day. For most participants within this group, meals included sandwiches, salads, pasta, meat dishes, and fast foods. In one particular case, the individual recorded as having eaten half of a turkey sandwich with lettuce, one pear, 12 ounces of Sierra Mist, and four chocolate chip cookies for lunch. The same individual ate broiled chicken thighs with seasoning, sautéed mixed vegetables with onions and garlic, two Pillsbury biscuits, and one Klondike oreo bar ice cream for dinner.

Whether participants consumed entirely American meals as the individual described previously, followed a diet consisting of primarily Indian meals, or a combination of both cuisines depended on several factors.

Table 2 **Composition of Diets According to Age**

Age Range	Total # of Individuals in Age Range	# Eating Indian Meals	# Eating a Combination of American and Indian Meals	# Eating American Meals	% Eating Indian Meals	% Eating American/Indian Meals	% Eating American Meals
10-19	5	0	2	3	0%	40%	60%
20-29	12	3	2	7	25%	17%	58%
30-39	7	3	2	2	43%	29%	29%
40-49	5	2	2	1	40%	40%	20%
50-59	6	4	2	0	67%	33%	0%
60-69	5	2	2	0	40%	40%	0%
Missing	11	8	3	1	73%	27%	9%

The table above reveals one of the more apparent associations; that between the age of the individual and the diets consumed. Within the population, those in their teens and twenties consumed mostly American meals, 60% and 58% respectively, during the day. Nevertheless, these two groups differ in their consumption of Indian meals. While those between the ages of 10

and 19 only included a maximum of one Indian meal into their daily diet, nearly 25% of the individuals in their 20s were eating a largely Indian diet. This trend toward the inclusion of more Indian meals continues with those in their 30s and 40s. Fewer and fewer individuals within this age group are seen consuming an entirely American diet. Although moving toward an Indian diet, some proportion of those in their 30s and 40s consume all three types of diets discussed previously. Unlike those in their 30s and 40s, participants in their 50s and 60s have moved away from the all-American diet completely. Most of these individuals are eating at least one Indian meal daily, if not more. Despite further observance of an Indian diet within this older group, American meals have not been abandoned altogether. Nearly 33% of those in their 50s and 40% of those in their 60s consume a diet composed of both American and Indian meals. The data provided appears to suggest that Indian meals come to compose a greater proportion of an individual's diet with increasing age.

As depicted in Table 3 below, the particular diet observed also varied in accordance with the individual's duration as a resident in the U.S. Those participants who have resided in the U.S. for less than 11 years were found to have diets composed of largely Indian meals. This was particularly true for those who had been in the country for less than five years. After a period of five years, the data revealed a gradual incorporation of American foods into the diet. Among those who have lived in the U.S. for six to eleven years, 67% were found to consume a diet composed of both American and Indian foods.

Table 3 **Diets in Relation to Number of Years in the U.S.**

# of Years in the U.S	Total # of Individuals	# Eating Indian Meals	# Eating American /Indian Meals	# Eating American Meals	% Eating Indian Meals	% Eating American /Indian Meals	% Eating American Meals
0-5	4	4	0	0	100%	0%	0%
6-11	3	1	2	0	33%	67%	0%
12-17	12	5	3	4	42%	25%	33%
18-23	5	4	0	1	80%	0%	20%
24-29	2	0	1	1	0%	50%	50%
30-35	3	0	2	1	0%	67%	33%
U.S. Born	10	0	4	6	0%	40%	60%
Missing	12	8	3	1	67%	25%	8.3%

Greater inclusion of American foods and all-American diets exist in those participants who have resided in the U.S. between 12 and 25 years. The 0% of individuals among those having 18-23 years of residence in the U.S. is certainly unexpected, but the explanation may exist in the small size of the population. Nevertheless, in considering that 33% of participants with 12-17 years residence and 20% of individuals with 18-23 years residence are following an American diet, it becomes apparent that individuals have begun to move toward American cuisine. The resulting decrease in the consumption of Indian meals is perhaps most evident in those participants who have lived in the U.S. for more than 24 years. Individuals among this group have completely abandoned a largely Indian diet. They have moved toward a diet composed of either American and Indian foods or one primarily of American foods. This increased consumption of American cuisine is perhaps most exaggerated in those born in the United States, as nearly 60% of these individuals follow a largely American diet. Although, a significant shift toward American cuisine

develops with prolonged residence in the United States, the South Indians within this survey population have not eliminated typical Indian meals from their diets. Many of those who have been in the U.S. for more than 24 years or were born here reported as having one Indian meal during the day. Nonetheless, the general trend within the population reveals that as length of residence in the United States increases, the individual grows distant from a primarily traditional Indian diet.

The individual's dietary habits also appear to differ in association with the age at which the individual arrived in the United States (Table 4).

Table 4 Diets In Relation to Age at Arrival in the U.S.

Age at Arrival in U.S.	Total # of Individuals	# Eating Indian Meals	# Eating American /Indian Meals	# Eating American Meals	% Eating Indian Meals	% Eating American /Indian Meals	% Eating American Meals
U.S. Born	10	0	4	6	0%	40%	60%
0-10	9	1	2	6	11%	22%	67%
11-20*	2	2	0	0	100%	0%	0%
21-30	13	7	5	1	54%	38%	7.7%
31-40	8	5	2	1	63%	25%	12.5%
41-50	4	3	1	0	75%	25%	0%
51-60	2	2	0	0	100%	0%	0%
Missing	3	2	1	0	67%	33%	0%

*One individual 18, duration in U.S. unknown; other individual 19 and has been in the U.S. for 2 years.

Those who were born in the U.S. or arrived while still young (under the age of ten) consumed a primarily American diet. While U.S. born individuals in the study population did not consume more than one Indian meal during the course of the day, a small proportion of those who arrived while still young did eat more than one typical Indian meal. Participants who arrived in the U.S. in their late teens or 20s were found to follow a largely Indian diet with only 38% displaying any

incorporation of American foods. Among those arriving in their 30s and 40s, even less inclusion of American cuisine is observed. In fact, only 25% of those in their 30s and 40s follow a diet comprised of both American and Indian foods. This incorporation of both cuisines grows even more insignificant in the diets of those who immigrated to the U.S. in their 50s. Within this survey population, it became more likely for the individual to observe a traditional Indian diet as their age upon arrival to the U.S. increased. Although, the significance of an individual's age at immigration to his or her diet is presented distinctly from other factors, it is undoubtedly intertwined with the duration of residence and the individual's current age. For, a person who arrived in the U.S. when only six and has resided in the United States for more than 25 years will be more likely to observe a primarily American diet than an individual who arrived at 50 years of age and has only lived in the U.S. for 2 years.

The association seen between time and the variation in diets does not appear to hold true in the case of gender.

Table 5 Differences in Composition of Diets According to Gender

Gender	Total # of Individuals	# Eating Indian Meals	# Eating American /Indian Meals	# Eating American Meals	% Eating Indian Meals	% Eating American /Indian Meals	% Eating American Meals
Male	19	8	6	5	42%	32%	26%
Female	26	11	7	8	42%	27%	31%
Missing	6	3	2	1	50%	33%	16.6%

In comparison of gender with the form of diet followed in table 5 above, both males and females are observed to consume all three types of diets in relatively similar proportions. Given this, it is interesting to note that the prevalence of diabetes in this survey population is nearly three times greater in the male participants (Table 6).

Table 6 **Distribution of Diabetes According to Gender**

Gender	Total # of Individuals	Type I	Type II	Missing	% with Diabetes
Males	19	0	5	1**	32%
Females	26	1	2	0	12%
Missing	6	0	0	1*	0%

*the individual indicated no knowledge of diabetes, so it is assumed that he/she does not have diabetes.

**the individual reported as being diabetic, but is unsure of the Type.

Table 7 **Variation of Diet Among Diabetics**

Diabetes Type	Total # of Individuals	# Eating Indian Meals	# Eating American/Indian Meals	# Eating American Meals	% Eating Indian Meals	% Eating American/Indian Meals	% Eating American Meals
Type I	1	1	0	0	100%	0%	0%
Type II	7	4	2	1	57%	29%	14%
Missing	1	0	1	0	0%	100%	0%

Among the 51 participants in the survey, nine reported having either Type I or Type II diabetes, indicating a relatively high prevalence rate of 17% in the small population. When Type I and Type II diabetics were compared to the diets eaten, in table 7 above, a majority of the diabetics within this group were found to consume either a traditional Indian diet or one with a combination of American and Indian foods. Those with Type II appeared to vary in the diets observed, whereas the individual with Type I followed a strictly Indian diet. This observation however may be insignificant as only nine individuals from a population of 51 reported as being diabetic.

Table 8 **Prevalence of Diabetes in the Population**

Age Range	Total # in Range	Type I	Type II	Missing	% with Diabetes
10-19	5	0	0	0	0
20-29	12	0	0	0	0
30-39	7	0	0	0	0
40-49	5	0	0	0	0
50-59	6	0	3	0	50%
60-69	5	1	1	1*	40%
Missing	11	0	3	1**	36%

*the individual indicated no knowledge of diabetes, so it is assumed that he/she does not have diabetes.

**the individual reported as being diabetic, but is unsure of the Type.

The prevalence of diabetes in the population was found to concentrate entirely among older individuals, as depicted in table 8 above. The data did not provide any insight into the progression of diabetes in relation to age as illustrated by Vekataraman et al. in their survey of a Gujarati population (Vekataraman, 2004: Fig 1). This was not unexpected given the small size of the survey population and the inability to categorize several participants because of omitted information.

Although, diabetes was not prevalent in those younger than 50 years of age, the diets of those within these age groups indicate the potential for an increased risk of diabetes. Those following a largely American diet are eating foods with very little fiber and increased amounts of trans fat. Most of their meals consist of salads, pasta, meats, and sandwiches that contain little fiber. Very few individuals consumed the fruits and vegetables that would contain the fiber required. These individuals also ate foods containing trans fat such as fast foods including tacos,

pizzas and Chinese foods. Additional sources of trans fat were derived from snacks, including sodas, cookies, donuts, potato chips, and cakes eaten by nearly every individual consuming an all American diet. Researchers have indicated that eating increasing amounts of foods containing these components could raise an individual's risk of developing diabetes (Bazzano, 2005:311).

Those observing a traditional Indian diet of two or more Indian meals each day did not appear to consume high levels of trans fat, as they did not snack to the degree or in the manner of those eating an American diet. Their source of trans fat primarily come from fried Indian foods, including fish and Indian sweets and mixtures, and the use of coconut. Individuals within this group also consumed relatively more vegetables, fruits, and whole grains that are good sources of fiber. Although the higher levels of fiber and smaller amounts of trans fats within the Indian diet appears more appropriate for those at risk of diabetes, the potential for the disease still exists because of the large amounts of carbohydrates consumed within the diet. Consistently eating carbohydrates that could elevate the glycemic load¹ within the body has been found to promote the development of Type II diabetes (Bazzano, 2005:312).

Considering the possibility of high glycemic loads within the typical Indian diet and the low fiber and high levels of trans fats in the American diet, those consuming a combination of both cuisines may be more likely to increase their risk of developing diabetes. These individuals readily consume the sodas, soups, salads, sandwiches, fast foods, and meat dishes seen among those eating a largely American diet. Although the rice, chapattis, and vegetables in the Indian meals eaten might supplement the lack of fiber in these foods, the increasing amounts of carbohydrates consumed may heighten the individual's glycemic load. The increased glycemic levels in addition to the trans fats consumed may work to increase the rate at which the

¹ This is the product of the glycemic index, the "glucose-raising" potential, of a food and the total amount of carbohydrate within the food (Bazzano, 2005:312).

individual would be likely to develop diabetes. This is not to suggest that observing a diet comprised of both American and Indian cuisine should be avoided. Rather, foods within both cuisines may be combined to promote a diet with foods low in its glycemic load, low amounts of trans fats, and high levels of fiber (Bazzano, 2005:315).

Diabetes: Concern and Knowledge

In addition to the diet recall, questions regarding the population's knowledge of the disease and concern for its implications were also asked. Among the 51 participants, most individuals indicated having some (51%) or a significant (43%) amount of knowledge about diabetes. In fact, only 5.9% of individuals stated that they did not know anything about the disease. A majority of these individuals learned of this information through the media (42%), while others pointed to their parents (31%) and physicians (20%) as sources of information. With continued investment in the media directly targeted toward Asian-Indians and by providing more resources and training for parents and physicians, three avenues of education and prevention can be developed for this population. Considering that 88.2% of those surveyed expressed concern regarding the disease, the effort spent in educating the population will prove cost-effective. Their concern combined with accurate knowledge will allow them to take initiatives early in life to prevent the onset of diabetes. With fewer individuals requiring the life-long management that accompanies the disease, the money saved by the health industry as well as the individuals can serve other purposes.

Discussion

Although the survey provided worthwhile initial insights into the population's concern for diabetes as well as dietary habits that may contribute to the development of diabetes, it was limited in several regards. Perhaps most importantly, the survey was conducted during a period of Lent in the Orthodox Christian calendar. Lasting fifty days, the Lent commenced on March 27th and ended with Easter Sunday on April 16th. During this period most individuals refrain from eating meat and therefore the sample population, a large proportion of who were devout Orthodox Christians, may have consumed greater quantities of grain, vegetables, and fish than under normal circumstances. Additionally, the survey results proved insufficient to make conclusions without assumptions regarding the diet most likely to increase the risk of diabetes. The lack of detailed diet recalls left uncertainties in the true composition of the meals consumed by certain individuals. Clarification of whether the chapattis included in an Indian meal were homemade or store-bought would have provided a better understanding of the types of fats and carbohydrates being consumed. As not all fats and carbohydrates contribute to the development of diabetes, knowing such details would have proved useful in determining the most diabetes promoting diet. Moreover, without actually quantifying the meals eaten it is difficult to conclude with certainty a diet composed of both Indian and American foods as most likely to lead to diabetes. This, however, was the conclusion reached following analysis of the surveys. Within the conclusion lies the assumption that the American foods eaten contained the trans fats known to increase the risk of diabetes, and the Indian meals consisted of the quantity and type of carbohydrates likely to promote the high glycemic loads associated with the onset of diabetes. Finally, as the survey was conducted of small subset of the Asian Indian population—Malayalee, Christian Indians, its results cannot be generalized to the entire ethnic group. Asian Indians

arising from India differ in their dietary habits and traditions according to the regions from which they originate and the religions they observe (Kulkarni, 2004:191). The results become less applicable when considering the numerous other groups classified as Asian-Indian, including those originating from Nepal, Sri Lanka, Bangladesh, and Pakistan.

Nonetheless, the survey did reveal some important aspects regarding the dietary habits of Asian Indians. Even among a small population in which the individuals are of the same religion and trace their ancestry to the same region within India, diets varied dramatically. Although the particular foods eaten may vary among the different groups of Asian-Indians, this trend may exist in those populations as well. Among the population of South Asians surveyed, the results revealed the consumption of three different diets. The diet a particular individual was likely to consume relied on their current age, their age upon immigration, as well as their length of residence in the United States (Tables 2, 3, 4). Those individuals who consumed a largely Indian diet were older in age, immigrated to the U.S. as adults, or had only resided in the U.S. for a brief period of time. On the other hand, those following an American diet have generally lived in the U.S. for more than ten years. Moreover, they were relatively young individuals or immigrants to the U.S. as children. The number of participants who reported eating a diet composed of both American and Indian foods appeared to increase with age. Most these individuals have been in the U.S. for at least five years, so they have incorporated American foods into their diet. They also arrived in the U.S. in adulthood, so very few of them have abandoned the consumption of Indian meals. With both of these factors in effect, these individuals have continued to observe a diet of both American and Indian cuisine. As these diets have the potential to increase an individual's risk of developing diabetes, it is important to acknowledge and understand their

composition. The means for developing prevention and education strategies lies in obtaining this knowledge.

A Future of Prevention

As a fast growing group in the United States and with nearly 83% of the surveyed population concerned about diabetes, campaigns targeted toward Asian Indians for prevention and education of diabetes have been overlooked (Mohanty, 2005: 477). Simply understanding the consumption patterns of individuals provides points of intervention. The survey conducted revealed that the diets adopted varied in relation to age upon immigration to the United States. Those who arrived when still very young were less likely to follow a largely Indian diet than an individual who immigrated as an adult (Table 4). Having an understanding of the diets people are likely to adopt upon immigration provides the opportunity for an early intervention. By speaking with individuals soon after immigration and assisting them to adopt healthy diets and lifestyles, the high fat diets and sedentary lifestyles led by most Asian Indian immigrants can be avoided. For the population of Asian Indian immigrants already present in the U.S., knowing an individual's length of residence in the U.S. provides insight into the diet followed. Of the small population of Asian Indians surveyed those who had resided in the U.S. for more than 12 years were more likely to have incorporated Americans foods into their diets. Consequently, this group consisted of more individuals following diets composed of all American foods or a combination of American and Indian foods. By using length of residence as an indicator of the diet observed, individuals can be targeted with suggestions of dietary changes most appropriate to their diets. Another point of intervention exists in understanding the diet of the diabetics already present in the immigrant Asian Indian population. Among the fifty-one individuals in the surveyed

population, only nine indicated as having diabetes. Consuming diets composed of primarily Indian meals or a combination of American and Indian foods; the consumption patterns of these diabetics did not vary significantly from those of non-diabetics. Apart from the lack of raw sugar in their meals, these individuals ate the very same breads and rice consumed by those without diabetes. This finding suggests a population subset in which immediate intervention in the form of education may reduce the need for medications and improve their overall standards of health to divert a wave of insulin-dependent diabetics.

Any attempts to institute prevention strategies within this Asian Indian population must take the form of diet and lifestyle modifications, as their low sensitivity to insulin and the resulting genetic predisposition toward diabetes cannot be changed. Dietary changes do not have to result in complete elimination of the foods composing the individual's diet. Rather, healthier alternatives for the foods already consumed can be found. Several studies have uncovered an inverse relationship between diabetes and whole grains (Bazzano, 2005:312). Therefore, increasing one's daily intake of whole grains may actually decrease the risk of developing diabetes (312). Consuming greater quantities of cereal fibers may also do the same, as research has displayed an inverse relationship between cereal fibers and diabetes (311-312). Further studies suggest that substituting saturated and trans fats in diets with vegetable, monosaturated, and polysaturated fats will reduce the likelihood of developing diabetes (311). In regards to diabetics, the American Diabetes Association encouraged accounting for the total amount of carbohydrates consumed in order to maintain appropriate glucose levels (312).

Although observing a healthy diet reduces the individual's risk of developing diabetes, the link between obesity and diabetes requires modifications in the inactive lifestyles of many Asian Indians. In a lifestyle intervention conducted in China with 557 individuals considered to

have “impaired glucose intolerance,” the prevalence of diabetes reduced to 46% in a group receiving intervention by means of both diet and exercise. Over a period of the same six years the control group, which did not receive any form of intervention, displayed a prevalence rate of 67.7% (Bazzano, 2005:314). According to an analysis of nearly 70,000 individuals from the Nurses Health Study, lifestyle modification does not have to include the introduction of an extreme exercise regime. During the course of eight years, the impact of walking and vigorous activity on the incidence of diabetes revealed similar results. Those who walked the most and those who participated in vigorous activity were both 26% less likely to develop diabetes when compared to individuals leading inactive lifestyles (Mohanty, 2005:313). Simply by walking daily, individuals at risk can be expected to dramatically reduce their potential for developing diabetes. Regardless of the type of activity chosen, individuals must maintain favorable weights in order to reduce their risks of developing diabetes. Current estimates suggest that those at risk should attempt to maintain BMI values between 18.5 and 23kg/m² (Misra, 2004:486). In the case of Asian Indians, for whom greater correlation exists between waist-hip ratios and diabetes, waist circumferences of 90 cm in men and 80 cm in women are ideal (487). These guidelines as well diet and lifestyle interventions should emphasize the importance of weight maintenance, as research continues to demonstrate the strongest associations between obesity and diabetes.

The success of any intervention initiated and incorporation of prevention strategies relies upon the ability to drive large groups within the immigrant population to become concerned about diabetes. Research has revealed that individuals in the process of assimilation are bound to adopt “poorer diets and fewer health-promoting behaviors” if they do not have adequate social support (Diwan, 2001:58). For Asian Indians, churches, temples, and other religious institutions can serve as the foundations for these social support systems, as religion holds a signification

role in this ethnic group (Diwan, 2001:58-59). By using these institutions as distribution points for information regarding diabetes and related interventions, educators can build a shared knowledge among a large group. These groups can in turn act as social support systems for immigrants in the initial stages of acculturation. Provided contact with such large groups that are informed about diabetes and the means for prevention, it is expected that the newly immigrated individuals will adopt behaviors that will reduce their likelihood of developing diabetes. Taking the initiative to practice the appropriate behaviors is an essential component in the prevention of diabetes (Engelgau, 2003:S88). As so much of the act of prevention rests on the individual at risk, it is necessary for researchers and educators to keep these individuals well informed about the disease.

The importance of education and prevention cannot be overemphasized. "In 2002, [the cost of diabetes in the U.S. reached] approximately 132 billion dollars in direct medical costs and lost productivity" (Bazzano, 2005:310). The cost not only accounts for the management of diabetes, but also the complications including foot diseases, cardiovascular, and eye problems that may develop as a consequence of the illness (Engelgau, 2003:S88). For the individual, a diagnosis of diabetes results in a "reduction in life-expectancy and quality of life" (Bazzano, 2005:310). In fact, for a male and female diagnosed at the age of 40, the years lost from their lives are 11.6 and 14.3, respectively (310). This current situation as it exists now can be remedied if the avenues available through parents, doctors, and the media are used to inform and institute prevention programs for at risk populations, including Asian Indians. If the importance of prevention and education is not recognized, then the number of diabetics, a large proportion of which will include Asian Indians, may reach and surpass the 29 million estimated in the U.S. for the year 2050.

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