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ACCULTURATION AND ASSOCIATED FACTORS IN RELATION TO GLYCEMIC CONTROL AND SELF-MANAGEMENT OF DIABETES IN ASIAN INDIAN ADULTS IN THE U.S.

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By

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ABSTRACT

ACCULTURATION AND ASSOCIATED FACTORS IN RELATION TO GLYCEMIC CONTROL AND SELF-MANAGEMENT OF DIABETES IN ASIAN INDIAN ADULTS IN THE U.S.

By

Sumathi Venkatesh

Type 2 diabetes, is disproportionately high among Asian Indians (AI), one of the fastest growing immigrant groups in the United States. If diabetes is not identified early or well controlled as assessed by serum glycosylated hemoglobin (HbA1c), the propensity to develop devastating complications is greatly enhanced, and may lead to increased medical costs and premature death. Acculturation may be an important determinant of disease management and hence control. Therefore, a mixed method (descriptive quantitative and qualitative) study was conducted among 30 AI adults with physician diagnosed type 2 diabetes in acceptable (AC) (HbA1c <7%) (n=15) or unacceptable (UC) (HbA1c $\geq$7%) (n=15) glycemic control. Assessments of acculturation (SL-ASIA) and diet (initial and follow-up 24-hr recalls) were followed by an audio-taped in-depth interview that included socio-demographic, self-reported anthropometric, and open ended diabetes self-care questions. Interactions of acculturation with income (*interaction* b= 7.19; p= .01), duration of diabetes (*interaction* b= .30; p= .02), and body mass index (*interaction* b= 1.11; p= .01) significantly predicted higher HbA1c levels. Diabetes awareness, adherence to self-management behaviors, and support from physician friends/ family members were more evident in the perceptions of the AC versus the UC group. Cultural orientation and the patient's social and health care networks might be important for patient tailored interventions targeting AI with diabetes.

Dedicated to my family, friends, and teachers

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CHAPTER 1

INTRODUCTION

Diabetes is a globally prevalent, chronic, non-communicable disorder that has emerged as a serious public health challenge in the 21st century (Zimmet, 2000). About 2.8% (171 million) of the people in the world have diabetes, and the prevalence has been predicted to double (4.4% or 366 million) by 2030 (Wild et al., 2004). Diabetes-related mortality accounts for nearly 5% of all deaths annually (about 3.2 million people worldwide), which is projected to increase by more than 50% within the next decade (World Health Organization (WHO), 2004).

With about 31.7 million people affected, India has the highest absolute prevalence of diabetes among all countries, which is projected to grow to 80 million people by 2030 (Wild et al., 2004). Furthermore, the prevalence of diabetes has historically been much higher among immigrant Asian Indians than among the host population of the countries to which they emigrate or among Asian Indians living in India (Ramaiya et al., 1991).

Within the United States (U.S.), the prevalence of diagnosed type 2 diabetes in 2004 was 18.3% among Asian Indian adults in Atlanta, Georgia (Venkataraman et al., 2004). In a more recent large randomized national study by Misra et al (2009), the prevalence of diabetes and prediabetes was found to be 17.4% and 33%, respectively, among Asian Indians residing in seven urban cities in the U.S., where the majority of Asian Indians in the U.S. are located (U.S. Census Bureau, 2000). The rates documented by the above

studies are higher than that reported in the 2005-2006 National Health and Nutrition Examination Survey (NHANES) for Hispanics (8.4%), Blacks (12.8%), and Whites (6.6%) (Cowie et al., 2009)

The disproportionately high prevalence rates of diabetes among Asian Indians in the U.S. warrants investigation of disease management and hence control. Diabetes control is usually assessed using the Hemoglobin A1c (HbA1c) laboratory test, which measures glycemic control or the average concentration of glycated hemoglobin in the blood over a period of three months (Nathan et al., 2008). The HbA1c value is the best long term marker of glycemic control as it is not affected by the day to day variations in blood glucose levels (Sacks et al., 2002; Saudek et al., 2006).

Ethnic disparities are evident in both the prevalence of diabetes and glycemic control (Adams et al., 2008; Adams et al., 2005; Kirk et al., 2008; Kirk et al., 2006; Mukhopadhyay et al., 2006). A few cross-cultural comparison studies conducted in Singapore, the Netherlands, and Malaysia have shown Asian Indians to have poorer glycemic control than the mainstream/other ethnic populations (Hong et al., 2004; Ismail et al., 2000; Ray et al., 2007). In the U.S., despite the high prevalence of the disease among Asian Indians, relatively little information is available about their diabetes control.

It is estimated that 4.9% of individuals in the U.S. have undiagnosed diabetes (Cowie et al., 2009), and are not aware of their disease condition until the symptoms appear. If diabetes is either undiagnosed or poorly managed/controlled, the propensity to develop devastating complications is greatly enhanced and may result in premature death. For example, people with diabetes are at higher risk of stroke (Lehto et al., 1996), and heart disease (Fox et al., 2004) than those without the disease. Hypertension (Saydah et al., 2004), neuropathy (Klein et al., 1996), retinopathy (Bunce et al., 2006), end-stage renal disease (Foley et al., 2007; Perneger et al., 1994), and lower limb amputations are more likely to occur among people with diabetes. Weakness and fatigue are additional concerns among adults over 60 years (Centers for Disease Control and Prevention (CDC), 2008). Complications of diabetes can be reduced or prevented with a consistent tight glycemic control.

Critical to glycemic control, is strict adherence to key self-management practices recommended by the American Diabetes Association (ADA) as follows: healthy eating and associated weight management, regular exercise, self-monitoring of blood glucose, foot care, regular consultation with a physician, and compliance with prescribed medications. The ability and efficacy to perform self-management behaviors may be related to ethnicity, which was documented by Thackeray et al (2004) in a cross-sectional analysis of the Behavioral Risk Factor Surveillance System (BRFSS) survey. Based on this study, ethnic disparities were evident in diabetes self-management practices such as frequency of self-monitoring of blood glucose, frequency of HbA1c tests conducted

within the past year by a health professional, self-foot examination, type of medication prescriptions (insulin injections or oral medications), attending classes for diabetes education, ever having blood cholesterol checked, and engaging in vigorous physical activity after adjusting for sociodemographic factors and age at diagnosis of diabetes. Therefore, due to the existence of ethnic disparities in self-management practices, culturally sensitive and appropriate treatment programs are needed (Brown et al., 1995; Middelkoop et al., 2001; Philis-Tsimikas et al., 2004).

The Asian population including the Asian Indian specifically, is among the fastest growing immigrant groups in the U.S. (U.S. Census Bureau, 2000). A rapid rise in the number of Asian Indian immigrants occurred within the last two decades (about a fivefold increase from 387 thousand in 1980 to 1.9 million in 2000), constituting close to 1% of the total U.S. population and 16.2% of the Asian population (Frazier et al., 2006; U.S. Census Bureau, 2000). The majority (65%) of Asian Indians who reside in the U.S. came between 1990 and 2000, accounting for a 133% increase (Frazier et al., 2006). The enormous immigration to the U.S. warrants concomitant health status monitoring of this population because of the potential for serious health-related cost implications.

Since the prevalence of type 2 diabetes is high among Asian Indians in the U.S., adaptation to the western culture could be a potential determinant of the rising prevalence of the disease in this population. The extent to which immigrants adapt to the host culture in comparison to retaining their ethnic culture is termed acculturation. Acculturation

could be a critical factor to be considered relative to Asian Indians and other immigrant populations with regard to both diabetes prevalence and control.

An association between acculturation and increasing rates of diabetes, obesity, coronary artery disease risk, and poor diet quality has been identified in various ethnic groups (Aldrich et al., 2000; Dixon et al., 2000; Himmelgreen et al., 2004; Hubert et al., 2005; Kaplan et al., 2002; Lands et al., 1990; Marmot et al., 1976). A few studies on Arab immigrants and Mexican Americans, however, have documented the positive influences of acculturation on immigrants' health such as reduced risk for diabetes and lower rates of obesity than individuals with a lower degree of acculturation (Hazuda et al., 1991; Jaber et al., 2003). Evidence from acculturation studies conducted thus far is therefore inconsistent and reveals variations in health outcomes that may depend on the characteristics of the immigrant group. Therefore, the disease-acculturation link cannot easily be generalized for all immigrant ethnic groups.

There are relatively few studies examining the impact of acculturation of Asian Indians pertaining to their health outcomes. Mooteri et al (2004) found a significant association between the duration of residence in the U.S. (> 20 years) and the increased risk of coronary artery disease among first generation Asian Indian immigrants. Similarly, lifestyle behaviors such as physical activity, alcohol consumption, and dietary practices were also negatively affected. Although this study supports the notion that a longer duration of stay in the U.S. may lead to behavioral and lifestyle changes in Asian Indians,

this study did not assess acculturation status of participants. Acculturation and associated environmental (health care system, support network, location of residence and neighborhood characteristics), and individual (values, beliefs and diabetes knowledge) factors could be determinants of diabetes self-management behaviors. However, the relationship between diabetes self-management behaviors and acculturation has not been studied among Asian Indians in the U.S.

The relationship of acculturation to health outcomes is complex and difficult to study in populations with diverse religious, linguistic, and socio-demographic characteristics such as the Asian Indian. Quantitative data obtained from simple surveys may not adequately describe the cultural complexities and the perceptions of patients living with diabetes. Additionally, due to the racial/ethnic disparities in insulin resistance, diabetes prevalence, and susceptibility to related complications, it is challenging to select appropriate treatment methods and diabetes interventions targeting a particular ethnicity without knowing their specific problems and cultural practices.

Therefore, the paucity of data on acculturation in conjunction with other potentially influential (individual and environmental) factors, justifies a qualitative study in Asian Indians with type 2 diabetes. This information will provide rich in-depth data on the cultural perceptions and experiences of diabetes management among Asian Indians in the U.S. More specifically, barriers and facilitators to the management of diabetes in this vulnerable population will be identified.

Hence, the present study will contribute to the efficacious planning and execution of culture specific diabetes interventions targeting the Asian Indian population in the U.S. Michigan was chosen as a suitable place to conduct this study because of its large Asian Indian population. In 2000, with about 50,000 Asian Indians, the city of Detroit in Michigan was reported to be among the top 10 cities with a large number of Asian Indians (U.S. Census Bureau, 2000). Therefore, data from this study will provide a "snapshot" of a representative sample of Asian Indians in the U.S.

Research Objectives

The objectives of this study on Asian Indian adults with physician diagnosed diabetes and who were either in acceptable glycemic control (AC) (HbA1c< 7%) or unacceptable glycemic control (UC) (HbA1c≥ 7%) were: (i) to determine if and how acculturation is associated with diabetes control, and (ii) to describe and contrast self-management behaviors and related factors of subjects in the AC and UC groups.

Research Questions:

The research questions for this study as they pertain to Asian Indians with physician-diagnosed diabetes are as follows:

(i) Is acculturation related to glycemic control, and if so, how?

(ii) How do participants perceive the impact of the disease and the required self-management behaviors?

(iii) What do subjects perceive to be facilitators and barriers for better managing their diabetes?

(iv) How does location of residence influence self-management behaviors?

(v) How does the subjects' knowledge of diabetes affect their self-management behaviors?

(vi) How does the health care system influence self-management behaviors?

(vii) In what ways are support networks and self-management related?

(viii) How does an individual's values and beliefs influence self-management behaviors?

CHAPTER 2

REVIEW OF LITERATURE

The literature review consists of five sections: (i) overview of diabetes mellitus, (ii) diabetes among Asian Indians, (iii) a review of self-care behaviors as they relate to diabetes control, (iv) theoretical framework for diabetes self-management, and (v) factors that may influence self-management of diabetes.

2.1 Diabetes Mellitus

2.1.1 Classification, Risk Factors, and Pathology

Diabetes mellitus, the most common form of endocrine disorders worldwide, is a group of metabolic disorders rather than just a single disease (ADA, 2008a). Diabetes is characterized by high blood glucose concentration (hyperglycemia) due to defective secretion of the hormone insulin by the beta cells of the pancreas and/or impaired utilization of insulin by the cells of the body (WHO, 1999).

There are two primary forms of the disease: type 1 and type 2 (WHO, 1999). Type 1 diabetes is characterized by a deficiency in the production of insulin due to an auto immune disorder resulting in the destruction of the beta cells of the pancreas. Although the cause for beta cell destruction in individuals with type 1 diabetes is not known, it is believed to be due to genetic disposition and environmental factors such as viruses (ADA, 2008a; WHO, 1999). The exact role of environmental factors in relation to the development of type 1 diabetes however, is still under investigation. About 5-10% of

individuals with diabetes have type 1 diabetes (CDC, 2008), which requires an exogenous source of insulin for survival, specifically for the prevention of ketoacidosis, coma, and death (WHO, 1999). Although type 1 diabetes has predominantly been prevalent in children and adolescents, it has also been increasing in adults (WHO, 1999).

Type 2 diabetes is the predominant form of the disease present in about 90-95% of individuals diagnosed with diabetes (CDC, 2008). Type 2 diabetes is a combination of the body's resistance to the available insulin and an inadequate insulin secretory response (WHO, 1999). Type 2 diabetes typically begins with insulin resistance, which is a decreased ability of body cells to utilize the available insulin resulting in compensatory hyper-insulinemia and the pancreas gradually losing its ability to secrete adequate amounts of insulin (WHO, 1999). However, many individuals with type 2 diabetes do not necessarily need exogenous insulin for survival. This may change over time as beta cells progressively degenerate.

Diabetes is diagnosed using one of the three procedures listed in Table 2.1. For any of these methods, if the diagnosis of hyperglycemia was not clear or strong enough, a repeat testing should be done for confirmation (ADA, 2009). Although the fasting plasma glucose (FPG) is less sensitive than the Oral Glucose Tolerance Test (OGTT), it is the preferred test for the diagnosis of diabetes because of its ease of application and acceptability to patients (ADA, 2009). The OGTT is not recommended for routine clinical use due to poor reproducibility (ADA, 2009).

Table 2.1 Criteria for the diagnosis of diabetes mellitus (ADA, 2009).

Symptoms of hyperglycemia and a casual (random) plasma glucose ≥200mg/dl (11.1 mmol/l). Casual (random) is defined as any time of day without regard to time since last meal. The classic symptoms of hyperglycemic include polyuria, polydypsia, and unexplained weight loss.*
or
Fasting Plasma Glucose (FPG) ≥ 126 mg/dl (7.0 mmol/l). Fasting is defined as no caloric intake for at least 8 hours.
or
2-hour plasma glucose ≥200 mg/dl (11.1 mmol/l) during an Oral Glucose Tolerance Test (OGTT). The test should be performed as described by the World Health Organization using a glucose load containing the equivalent of 75 g anhydrous glucose dissolved in water.*
**In the absence of unequivocal hyperglycemia, these criteria should be confirmed by repeat testing on a different day*

Screening for diabetes will help identify individuals with an existing condition and those with pre-diabetes, who do not as yet exhibit adequate signs and symptoms to be classified as diabetes. In general, a fasting plasma glucose level of < 100 mg/dl is considered as normal (ADA, 2009). Pre-diabetes is a stage between normal glucose levels and that of diabetes with an impaired fasting glucose of ≥ 100 mg/dl but <126 mg/dl (ADA, 2009). In particular, screening is necessary every three years for individuals ≥45 years even in the absence of risk factors. Screening at an even earlier age is advised for individuals who are overweight and with an additional risk factor for diabetes (ADA, 2009).

Individuals with a family history of diabetes, women who have experienced gestational diabetes, obesity, and of a specific ethnicity (African American, Hispanic-American, Native American, Asian-American, and Pacific Islander) are at a higher risk of being affected with diabetes (Table 2.2) (ADA, 2009; WHO, 2004). Although type 2 diabetes was initially believed to be an adult onset disease, more children (as young as 6 years) and adolescents have been diagnosed with this disease in recent years (CDC, 2008), particularly in populations with high rates of diabetes among adults (Pihoker et al., 1998; Scott et al., 1997).

Table 2.2 Risk factors for type 2 diabetes (ADA, 2009).

Family history of diabetes (have a first degree relative with diabetes)
History of gestational diabetes or delivered a baby weighing $\geq$ 9 lbs
Impaired glucose tolerance or Impaired fasting glucose
Physical inactivity
Obesity
Race/ethnicity (e.g., African American, Hispanic/Latino American, American Indian, Asian-American, Native Hawaiian, or Pacific Islander)
Hypertension ($\geq$ 140/90 mmHg in adults)
HDL cholesterol $\leq$ 35mg/dl (0.90 mmol/L) and/or a triglyceride levels $\geq$250 mg/dl (2.82 mmol/L)
Polycystic ovarian syndrome
History of vascular disease
Other clinical conditions associated with insulin resistance (e.g., acanthosis nigricans)

Early detection of diabetes is imperative because if untreated or if poorly controlled, this disease could result in serious complications and/or premature death (Groeneveld et al., 2001). People with type 2 diabetes are at approximately two to four times higher risk of stroke (Lehto et al., 1996) and death rates from heart disease (Fox et al., 2004) than those without diabetes. Hypertension is a common problem among adults with diabetes (Saydah et al., 2004). Individuals with severe hyperglycemia may experience mild to

severe neuropathy and may have neuropathy-related and impaired sensation in their feet (Klein et al., 1996). They are also susceptible to diabetic foot ulcers (Ramsey et al., 1999) and dental disease (Mealey et al., 2000; Tsai et al., 2002). Lower limb amputations are more likely to occur among people with diabetes (Johannesson et al., 2009). Diabetes is one of the leading causes of blindness (Bunce et al., 2006) and end-stage renal disease (Foley et al., 2007; Perneger et al., 1994) Additional concerns in adults over 60 years include weakness and lack of energy to do normal activities and household chores (CDC, 2008).

Due to high rates of morbidity associated with the disease, individuals with diabetes are more likely to use medical care in the form of in-patient hospital care, outpatient physician office visits, emergency visits, and visits with multiple health professionals (ADA, 2008b). In addition, purchase of diabetes medications, prescription drugs to reduce associated complications, and medical supplies required for managing the disease further increases the medical expenditures of people with diabetes compared to those without the disease (ADA, 2008b).

The medical cost of people with diabetes is about thrice as that of those without diabetes (Trogdon et al., 2008). In addition, the cost of management of diabetes in the U.S. in 2007 was estimated to be $174 billion, which includes direct ($116 billion) and indirect ($58 billion) medical costs. The direct costs include general medical costs and expenses to directly treat diabetes and related complications. The indirect medical costs may

include disability, premature death, and limited employment or loss of work or work days (ADA, 2008b). By 2034 diabetes related annual direct cost is expected to rise to 336 billion (Huang et al., 2009). These associated complications and exorbitant costs of diabetes could be greatly minimized by maintaining or achieving blood glucose, lipid, and blood pressure control, all achievable by adhering to self-management recommendations of the American Diabetes Association.

2.1.2 Metabolic Monitoring

Glycemic control is assessed using the Hemoglobin A1c (HbA1c) laboratory test, which measures the amount of average concentration of glycated hemoglobin in the blood over a period of three months. Glycated hemoglobin formation is directly related to blood glucose concentration since continuous glycosylation occurs during the 120 day lifespan of erythrocytes (Saudek et al., 2006). Glycosylation occurs when blood sugar attaches to hemoglobin A, which constitutes about 90% of adult total hemoglobin (Goldstein et al., 2004). HbA1c, one of the minor components of HbA, results from posttranslational modification of HbA due to condensation with glucose (Bunn et al., 1976).

HbA1c percent increases in poorly controlled diabetes (Rahbar et al., 1969) and has been shown to be within normal limits when blood glucose is adequately controlled (Koenig et al., 1976). In this respect, the HbA1c test value was found to be highly correlated with mean plasma blood glucose levels on multiple testing over 2–3 months (Nathan et al., 2008). The HbA1c value is widely accepted as the best long term marker of glycemic

control since it is not affected by the day to day variations in blood glucose levels (Sacks et al., 2002; Saudek et al., 2006). The HbA1c is used for follow up with patients who have diabetes, to alter their medications and to foresee their risks for complications as warranted (ADA, 2009; Berg et al., 2008; Saudek et al., 2006).

According to the American Diabetes Association, an HbA1c value between 4-6% is considered normal; <7% is the target goal value for people with diabetes in general. Additional action and modification of medication is recommended for people with a HbA1c ≥8%. Less stringent goals are recommended for individuals with severe hypoglycemia, limited life expectancy, extensive co-morbidities, and advanced micro and/or macro vascular complications (ADA, 2009). The HbA1c cut points for the treatment goals were derived based on prospective randomized clinical trials such as the Diabetes Control and Complications Trial (DCCT, 1993) and the United Kingdom Prospective Diabetes Study (UKPDS, 1998) that showed the relationship between glycemic control and the risks for the development and progression diabetes-related complications.

The ADA recommends that the HbA1c test be conducted at least twice a year for people who meet their treatment goals and every three months for individuals who do not meet their goals or who have changed medications (ADA, 2009). Likewise, control of blood glucose and lipid profiles, and additional preventive care practices for micro and macro vascular diseases to avoid major complications in people with diabetes are also

recommended by the ADA (2009) and the CDC (2008) (Table 2.3 and 2.4). Therefore, in addition to glycemic control, blood lipids and other clinical parameters are also regarded as important adjuncts for metabolic disease monitoring. The primary goals of these biomedical recommendations are to help delay, prevent, or ameliorate complications of the disease.

Table 2.3 Biomedical management and recommendations by Centers for Disease Control and Prevention (CDC, 2008).

Glycemic control: Good glycemic control is essential for people with both type 1 or type 2 diabetes. There is a 40% decreased risk for micro and macro vascular complications if the HbA1c drops by at least 1% for those with abnormally high levels.
Blood pressure control: Reduces risk of heart disease or stroke by 33% to 50%. Reduces the risk of micro vascular complications by 33%. Every 10 mm Hg reduction in systolic blood pressure, if higher than normal, reduces the risk for any complication related to diabetes by 12%.
Control of blood lipids: Improved control of LDL cholesterol can reduce cardiovascular complications by 20% to 50%.
Preventive care practices for eyes, feet, and kidneys: Detecting and treating eye disease in people with diabetes can reduce the development of severe vision loss by 50% to 60%. Comprehensive foot care programs can reduce amputation rates by 45% to 85%. Detecting and treating early diabetic kidney disease can reduce the decline in kidney function by 30% to 70%.

Table 2.4 The recommendations of the American Diabetes Association for blood glucose and lipid profiles for adults with diabetes (ADA, 2009).

Glycemic Control	
A1c	<7.0%
Pre-prandial capillary plasma glucose	90 – 130 mg/dl (5.0 – 7.2 mmol/l)
Peak postprandial capillary plasma glucose	<180 mg/dl (<10.0 mmol/l)
Blood pressure	<130/80 mmHg
Lipids	
LDL	<100 mg/dl (<2.6 mmol/l)
Triglycerides	<150 mg/dl (<1.7 mmol/l)
HDL	>140 mg/dl (>1.1 mmol/l)

2.2 Diabetes among Asian Indians

2.2.1 Characteristics of Asian Indian Immigrants in the U.S.

Asian Indians are among the fastest growing immigrant groups and constitute nearly 1% (1.7 million) of the U.S. population (U.S. Census Bureau, 2000). Although Asian Indians started migrating to the U.S. from 1907, the Immigration and Nationality Act of 1965 that allowed 20,000 Asian Indians annually to the U.S. contributed to the significant growth in Asian Indian population (Frazier et al., 2003). India is the fourth major source to the U.S. in immigration; Frazier et al (2006) discussed how the growth of the Asian population in the U.S. always exceeded projected values. Now, although 77% of Asian Indians in the U.S. are foreign born about 30% of these are naturalized citizens (U.S. Census Bureau, 2000). However, based on the above evidence, it is likely that the actual growth will surpass this estimation.

The Asian Indian group in the U.S. is a relatively young (median age: 30.3 years) community with only about 4% in the 65 years or older age group. Seventy seven percent of Asian Indians in the U.S. are foreign born; however, about 30% of the foreign born Asian Indians are naturalized citizens (U.S. Census Bureau, 2000). In general, Asian Indians in the U.S. are predominantly settled in the metropolitan areas. They have the highest educational level and more likely to be in management, professional or related occupations among all the Asian groups with a median income greater than the U.S. general population (U.S. Census Bureau, 2000). Although the proportion of Asian Indian females (46%) in the U.S. is almost equal to males, female participation in the labor force is lower than males. Asian Indians are predominantly Hindus followed by Sikhs, Buddhists, Jains, Christians, and Muslims. Since English is recognized as one of the official languages in India, urban Asian Indians who immigrate to the U.S. are well versed in written and spoken forms of the respective language (Mehta et al., 1991). The majority of Asian Indians in the U.S. are good at spoken English (80%) with about 20% of them speaking exclusively English at home (U.S. Census Bureau, 2000).

2.2.2 Prevalence of Diabetes in Asian Indians

India has the highest absolute prevalence of diabetes among all countries. In 2000, 31.7 million people in India were affected with diabetes, which is more than China (20.8 million), and the U.S. (17.7 million) (Wild et al., 2004). Data from national epidemiological studies that have been conducted within these countries shows a higher prevalence of diagnosed diabetes of 12.1% in India (Ramachandran et al., 2001)

compared to 1.3% in China (Gu et al., 2002), or 7.7% in the U.S. (Cowie et al., 2009). It has been projected that the diabetes prevalence among Asian Indians in India will continue to grow with nearly 80 million affected by 2030 (Wild et al., 2004).

Within India, the prevalence of diabetes is rapidly escalating as evidenced by The Chennai Urban Rural Epidemiology Study (CURES) (Mohan et al., 2006). The CURES study documented the prevalence of diabetes among adults ≥20 years in Chennai, a metropolitan city in Southern India in 2000 to be 15.5%, which is a significant increase by 72.3% from 1989 to 2004 (Mohan et al., 2006). Furthermore, studies that compared the diabetes prevalence in rural vs. urban India documented a higher prevalence among the urban (7.3 -8.2%) than the rural (2.4 – 3.1%) population (Mohan et al., 2008; Ramachandran et al., 1992). It has been shown that lifestyle changes associated with urbanization play a major role in the high prevalence of diabetes in the urban regions of India (Ramachandran et al., 1999).

Furthermore, studies have documented a higher diabetes prevalence among Asian Indians/South Asians (individuals from Pakistan, Sri Lanka, Nepal, and Bangladesh) residing in other countries than the host population of those countries. In countries with a considerable Asian Indian population, such as the United Kingdom (U.K.) (10.0% in a predominantly Asian Indian community vs. 3.5% in whites (Simmons et al, 1989); Canada (6.2% in South Asians vs. 2.2% in Caucasians (Anand et al., 2000), Singapore (8.9% in Asian Indians vs. 7.6% in Malaysians (Thai et al., 1987), Mauritius (12.8% in

Asian Indians vs. 11.5 in Creoles (Dowse et al., 1990), Fiji (11.9% in Asian Indians vs. 5.3% in Melanesians (Zimmet et al, 1983) , Trinidad (20.5% in Asian Indians vs. 12.5% in Africans (Beckles et al., 1986), and South Africa (10.4% in Asian Indians vs. 3.6% in Africans (Marine et al.,1969), the prevalence of diabetes was found to be higher among Asian Indians compared to the host population.

Within the U.S., Venkataraman et al (2004) and Misra et al (2009) documented the prevalence estimates of diabetes among Asian Indians, which were much higher than the percentage with diagnosed diabetes among non-Hispanic blacks (12.8%), non-Hispanic whites (6.6%), and Hispanics (8.4%) in the NHANES 2005-2006 survey (Cowie et al., 2009). A survey conducted by Venkataraman et al (2004) on 1,046 Guajarati Hindu Asian Indian immigrants living in Georgia, was claimed to be the first study to determine the prevalence of diabetes among Asian Indians in the U.S. The study included a questionnaire that consisted of socio-demographic information, anthropometric profiles, and questions about the presence of diabetes and related co-morbidities. According to this study, the prevalence of diabetes among Asian Indians in 2004 was 18.3% (22.5 % in men and 13.2 % in women). This study documented age, male gender, and family history of diabetes to be independent predictors for diabetes (Venkataraman et al., 2004).

A more recent randomized national study was conducted by Misra and colleagues (2009) in seven major urban cities where majority of Asian Indians in the U.S. are located (U.S. Census Bureau, 2000). The study findings showed the prevalence of type 2 diabetes and prediabetes among 1,038 Asian Indian adults $\geq$18 years to be 17.4% and 33%,

respectively. The study participants also exhibited abnormal lipid profiles, a major risk factor for cardiovascular disease.

Mohanty et al (2005) conducted a cross sectional study of the National Health Interview Survey (NHIS) for 1997 – 2000 on 87,846 non-Hispanic whites and 555 Asian Indian adults. Asian Indians, despite having a significantly lower Body Mass Index (BMI) than non-Hispanic whites (24.0 vs. 26.2; $p<.0001$), had a greater likelihood of having diabetes (OR: 2.7; 95%CI: 1.7 – 4.2) after adjusting for age and BMI than non-Hispanic whites (Mohanty et al., 2005). Similarly, another cross-sectional study of the National Health Interview Survey (NHIS) for 1997 – 2005 documented that Asian Indians were more likely to have diabetes (OR: 3.1; 95%CI: 2.4 – 4.0) than non-Hispanic whites, after adjusting for age, sex, and BMI (Oza-Frank et al., 2009).

2.2.3 Genetic Susceptibility of Asian Indians to Diabetes

Certain genetic risk factors of diabetes such as a high prevalence of insulin resistance, abdominal obesity, and abnormal lipid profiles have been shown to be common in the Asian Indian population (Banerji et al., 1999; Chandalia et al., 1999; Enas, 2002; Misra et al., 2004; Raji et al., 2001; Ramachandran et al, 2004; Ramachandran, 1998). This cluster of abnormalities is collectively termed as 'Metabolic syndrome' (The National Cholesterol Education Program's Adult Treatment Panel III (NCEP), 2001). Such a cluster of metabolic disorders, characteristic of Asian Indians, has been termed the "Asian Indian Phenotype" (Joshi, 2003), which predisposes Asian Indians to a higher risk

of type 2 diabetes and increased risk of metabolic complications even at a relatively lower BMI (Banerji et al., 1999; Raji et al., 2001; Ramachandran et al, 2004). This "lean phenotype" of type 2 diabetes among South Asians may be different from the characteristic type 2 diabetes prevalent among Caucasians; however there is insufficient evidence to support this assumption (WHO, 1999).

One explanation for the increased risk for type 2 diabetes among Asian Indians despite the lower BMI could be related to the fact that Asian Indians have high percentage body fat despite a lower waist circumference, when compared to Caucasians (Chandalia et al., 1999). The International Diabetes Federation (IDF) recommends ethnic specific threshold values for waist circumference for the diagnosis of metabolic syndrome. While the criteria of waist circumference as a measure of central obesity is the same for South Asian and Caucasian women ($\geq$80 cm), it is however 4 cm lower for males of South Asian ($\geq$90 cm) than Caucasian ($\geq$94 cm) origin (International Diabetes Federation (IDF), 2005).

In a study that compared 64 Europeans, 31 Pacific Islanders and 19 Asian Indians in New Zealand, Asian Indians had a mean body fat % of 28.8 compared to the mean of 19.4 % and 22.7 % for the Europeans and Pacific Islanders, respectively (Rush et al., 2004). In this study, the appendicular skeletal muscle mass and bone mineral content were found to be the least in Asian Indians; however, the abdominal fat was significantly higher than Europeans and Pacific Islanders. Furthermore, due to a higher percentage of central body

fat in individuals of Asian origin overall, the BMI cut points for defining normal weight (18.5 – 22.9) and overweight (≥23) have been lowered for Asians (Inoue et al., 2000). According to the proposed classification of weight by BMI for Asians, overweight is further classified as at risk for overweight (23 – 24.9), obese I (25 – 29.9), and obese II (≥30) (Inoue et al., 2000).

Furthermore, using 123 healthy volunteers in India, Dudeja et al (2001) included body fat percent to establish appropriate cut points to define overweight for Asian Indians. Based on the calculated body fat percentage (21.3 for males and 35.4 for females), a lower BMI cut point of 21.5 for males and 19.0 for females yielded the optimal sensitivity and specificity in identifying subjects with high percentage of body fat (Dudeja et al., 2001). Therefore, this study suggests a much lower BMI upper threshold in the classification of weight status of Asian Indians due to their high body fat percentage.

Based on the 'Thrifty Genotype Hypothesis' proposed by Neel (1962), the increased predisposition to diabetes or obesity of specific ethnic groups could be due to the inherited hunter-gatherer genes. This theory purports that because hunter-gatherers were exposed to famine situations often, physiological genetic adaptations for energy conservation and or storage occurred. Prentice et al (2005) articulated the generalizability of the 'Thrifty Genotype Hypothesis' to developing countries that had experienced a history of prolonged and mass starvation due to inadequate agricultural yields. Such populations e.g. Asian Indian immigrants, when exposed to abundance or western

lifestyles, experience gene-environment interactions, which may lead to an increased likelihood of developing metabolic disorders (Bajaj et al., 2004).

On the other hand, researchers argue that the 'Thrifty phenotype Hypothesis' could possibly lead to the origin of disease in the fetal stage, based on the 'Fetal Origin Hypothesis' theory. According to the 'Thrifty Phenotype Hypothesis', maternal malnutrition leads to poor fetal and infant nutrition thereby resulting in poor development and functioning of pancreatic beta cells, other organ malfunctions, and insulin resistance (Hales, 2001). In accordance with the 'Fetal origin' hypothesis, Yajnik et al (2002) compared neonates of Asian Indian and Caucasian origin and showed that although Asian Indian babies had lower birth weights, they had higher circulating insulin and adiposity after adjusting for birth weight. Thus, diabetes in Asian Indians could be further complicated by their genetic risk factors that predispose them to an increased risk of type 2 diabetes. For Asian Indians who have diabetes, early diagnosis as well as adequate metabolic and glycemic control is therefore vital to prevent or delay complications.

2.2.4 Glycemic and Metabolic Control of Asian Indians with Diabetes

Examination of data from the UKPDS trial showed Asian Indian ethnicity to be associated with diabetes related complications such as albuminuria and renal impairment (Retnakaran et al., 2006). Inadequate control of diabetes would further aggravate the severity of the disease and susceptibility to related complications in this population. In a few cross-cultural comparison studies that have been published, Asian Indians were

found to have higher HbA1c levels than the compared ethnic groups. In Singapore, between Chinese (n = 792), Malay (n = 69), and Asian Indian (n = 106) patients with diabetes, mean HbA1c levels were significantly higher for Asian Indians (8.36%) compared to Chinese (7.65%) and Malays (8.18%). About 22% and 50% of Asian Indians in this study had heart disease and a family history of diabetes, respectively (Hong et al., 2004).

In the Netherlands, between 48 Asian Indians and 48 Caucasians with diabetes, the mean HbA1c level of the Asian Indians (7.85%) was significantly higher (p=.01) than that for the Caucasians (7.20%) (Ray et al., 2007). In Malaysia, Ismail and colleagues (2000) compared Chinese, Asian Indian and Malay people with diabetes and showed Asian Indians to have higher HbA1c levels. In this study, for type 1 diabetes, the mean HbA1c was the highest among Asian Indians (n = 92; HbA1c = 9.6%) compared to Chinese (n = 118; HbA1c = 8.1%) and Malays (n = 119; HbA1c = 8.9%). For patients with type 2 diabetes, the mean HbA1c was higher for Asian Indians (n = 161; HbA1c = 8.5%) than Chinese (n = 134; HbA1c = 8.0%), but similar to that for Malays (n = 302; HbA1c = 8.8%). Thus studies have shown poorer diabetes control among Asian Indians when compared to other Asians or Caucasians. The HbA1c levels of Asian Indians as evidenced by the above studies are higher than the target glycemic control recommended for diabetes patients (< 7%) by The American Diabetes Association (ADA, 2009), and therefore warrants concern.

Within India, in an urban population in Chennai, the HbA1c was found to be 8.2%, 9.5%, and 11.0% in Asian Indians with normoalbuminuria, microalbuminuria and macroalbuminuria with retinopathy, respectively (Unnikrishnan et al., 2007). Adherence to diabetes self-management practices is therefore critical because glycemic control is directly related to the severity of the related complications as demonstrated by the Chennai study.

2.3 Diabetes Self-management Behaviors

The most essential self-management practices as recommended by the American Diabetes Association (ADA, 2009) that are complex and demanding, but critical to good control of diabetes are: healthy dietary practices, an appropriate physical activity regimen, compliance with prescribed medications, home blood glucose monitoring, healthy weight management, foot care, and regular consultation with a physician (ADA, 2009). Lifestyle interventions that included healthy eating, weight management, and physical activity have been shown to be associated with a reduction in the progression of the disease in individuals who have and are at risk for diabetes (Lemon et al., 2004; Tuomilehto et al., 2001; Williamson et al., 2009). Misra et al (2004) suggests early initiation of diabetes preventive measures such as healthy dietary habits, an active lifestyle and weight control for Asian Indians due to their high risk for the disease. Patient self-management of diabetes is therefore undoubtedly important for attaining diabetes control.

2.3.1 Healthy Dietary Practices

Dietary behavior plays a significant role in the occurrence and control of metabolic disorders, particularly type 2 diabetes. The major nutrition recommendations and interventions suggested by ADA are summarized in Table 2.5. The ADA (2009) recommends individualized medical nutrition therapy for people with diabetes to achieve treatment goals. Consideration of the amount and type of carbohydrate consumed is important for people with diabetes as it may influence blood glucose level. Although people with diabetes should monitor their carbohydrate intake, low-carbohydrate diets by restricting total carbohydrate to $\leq$130 g/day are not recommended (ADA, 2009).

Some of the ways by which carbohydrate intake could be monitored are carbohydrate counting, exchanges, or experience based estimation (ADA, 2009). The use of glycemic index (relative blood glucose response to carbohydrate containing foods) and glycemic load (glycemic index times dietary carbohydrate content) may provide additional benefits to monitor dietary carbohydrate intake (ADA, 2009). However, the total amount of carbohydrates in foods consumed is more important than the type or source of carbohydrates in diabetes patients (Franz et al., 2002). Furthermore, there is insufficient evidence to support the long term effects of low glycemic index diets (Franz et al., 2002).

Table 2.5 Nutrition recommendations by The American Diabetes Association (ADA, 2009).

	Recommendation
Amount and type of carbohydrate	130g/day, low-carbohydrate diets, restricting total carbohydrates to < 130g/day, are not recommended in the management of diabetes
Fiber	≥ 5g fiber/serving, or ~50g fiber/day
Sweeteners	Reduced calorie/non-nutritive sweeteners approved by FDA
Dietary fat and Cholesterol	< 7% total calories from saturated fats < 200 mg/day dietary cholesterol
Protein	15-20% of total energy
Alcohol	Two drinks per day or less for men, one drink per day or less for women
Specific for type 2 diabetes	Reduce intakes of: Total energy Saturated and *trans* fatty acids Cholesterol Sodium Increase physical activity

Recommendations for protein, fiber, and alcohol for the general population and individuals with diabetes appear to be the same (ADA, 2009). For those with normal renal function usual protein intake should be 15-20% of total energy. A food containing ≥5g of fiber per serving and a diet adequate in fiber rich foods such as fruits, vegetables, whole grain products, fiber rich cereals and legumes is often recommended. Alcohol consumption should be limited to a moderate amount of ≤ one drink per day for adult women and ≤ two drinks per day for adult men. While moderate alcohol consumption by diabetes patients has been shown to be associated with reduced fasting blood glucose (Shai et al., 2007) and HbA1c levels (Kroenke et al., 2003), and reduced risk for coronary heart disease (Solomon et al., 2000; Tanasescu et al., 2001), the long term effects of

alcohol consumption on glycemic control and the impact of alcohol consumption on diabetes self-management behaviors is still unclear (Howard et al., 2004).

Sugar alcohols (erythritol, isomalt, lactitol, maltitol, mannitol, sorbitol, xylitol, tagatose, and hydrogenated starch hydrolysates) and non-nutritive sweeteners (acesulfame potassium, aspartame, neotame, saccharin, and sucralose) approved for use in the U.S. are safe when consumed within the acceptable daily intake levels established by the Food and Drug Administration (FDA). However, the use of sugar alcohols may sometimes cause diarrhea and there is no concrete evidence to support the use of FDA approved non-nutritive sweeteners for the long term improvement in glycemic control (Franz et al., 2002). Lifestyle modifications by reducing total calorie intake, saturated fats (<7% of total calories), trans fatty acids, cholesterol, and sodium, and performing at least 150 minutes/ week of moderate physical activity are encouraged in type 2 diabetes patients to improve glycemic control, lipid control, and blood pressure (ADA, 2009).

Asian Indians in India consume excess refined carbohydrates such as dehulled white rice, semolina, and white flour, which were shown to be associated with insulin resistance and metabolic syndrome (Radhika et al., 2009). Asian Indians in southern India eat more rice versus the larger quantities of wheat consumed in northern India (Malhotra, 1970; Prashantham, 2008). Classification of foods into vegetarian and non-vegetarian is quite common in India, with varying degrees of frequency and strictness in adhering to vegetarianism (Prashantham, 2008). A variety of spices are often used in cooking and

eating habits of Asian Indians are to some extent determined by religion because Hindus avoid beef and Muslims do not consume pork (Prashantham, 2008).

South Asians in the U.K. with diabetes have been shown to exhibit poor dietary practices. In studies conducted on Asian Indians with diabetes, the majority did not follow a healthy diet for diabetes despite physician recommendations (Baradaran et al., 2004; Naeem, 2003). In general, in the 1999 Health Survey for England, South Asians were found to consume low amounts of fruits and vegetables, while the consumption of red meat and total fat intake was lower among the Asian Indian sub-group (Stanner, 2001). Likewise, Patel et al (2006) documented higher energy and fat intake among Guajarati Asian Indians in Britain when compared to age, gender, and caste matched Asian Indians in India. These patterns may be similar for those with diabetes.

Within the U.S., Jonnalagadda et al (2002) conducted a telephone survey to study dietary patterns of 237 Asian Indian adults ($\geq$ 40 years) who had lived in the U.S. for at least five years. Participants' diets were assessed using a modified version of the Block Fat and Fiber Screener. While fat intake was within the recommendations, participants' diets were deficient in dietary fiber content. The authors showed that almost half of the study participants (43%) were overweight with a BMI $\geq$25, which was positively correlated with total fat intake ($r=.027$; $p<.05$).

The ADA recommends a minimal intake of trans fat and restriction of saturated fats to less than 7% of total calories (ADA, 2009). An important dietary concern of particular interest to the Asian Indian population is the consumption of trans fat and saturated fat in the form of hydrogenated vegetable oil and clarified butter (ghee), respectively. While many countries are advocating avoidance of trans fatty acids, there is a likelihood of an increased intake of trans fats in India in the future due to increased consumption of 'vanaspathi', a form of hydrogenated fat that is used in Asian Indian cooking to replace clarified butter (ghee) (Misra et al (2001).

Raj et al (1999) examined the changes in dietary habits after immigration to the U.S. among seventy three Asian Indians in relation to length of residence in the U.S. Asian Indians who have been in the U.S. for more than 10 years were shown to decrease the use of clarified butter (ghee), butter, yogurt, and milk. In the study findings, Asian Indians, in general had reduced the frequency of traditional mixed dishes made with legumes, vegetables, and cereals because they require increased cooking time. Typical snacks that were consumed during the week included apples, cookies, nuts, milk, crackers, and chips, while energy dense Asian Indian sweet and salty foods were consumed at social gatherings during the weekends. The consumption of carbonated drinks, fruit juice, snacks, fruits, margarine, and alcoholic beverages however, increased regardless of the length of stay in the U.S. (Raj et al., 1999).

Although the study by Raj et al (1999) showed decreased consumption of saturated fat by Asian Indian immigrants who had stayed for a longer duration in the U.S., evidence from another study in the U.K. has shown increased consumption of saturated fat in the form of 'ghee' by Asian Indians (Naeem, 2003). 'Ghee, which is commonly used in cooking among Asian Indians, has been shown to have cholesterol oxides that might be the potential cause of the high risk of atherosclerosis in this population (Jacobson, 1987). Therefore health professionals should be aware of the concerns and trends in the Asian Indian diet and provide individualized dietary advice to Asian Indians with diabetes.

2.3.2 Physical Activity

Physical inactivity is an important behavioral risk factor for type 2 diabetes as well as other major metabolic disorders. A joint initiative of the International Diabetes Federation (IDF) and the World Health Organization (WHO) mentions physical inactivity to be a major global health risk which is prevalent in industrialized and developing countries, especially in urban areas (WHO, 2004). Compared to the U.K., fewer large studies conducted in the U.S., have documented the physical activity level of Asian Indians. Mohanty et al (2005) performed a cross-sectional analysis of the National Health Interview Survey (NHIS) survey for 1997-2000. Among 555 Asian Indians in the U.S., 67% were found to be sedentary or never active and only 33% indulged in vigorous physical activity. In a cross-cultural study conducted in Texas, Asian Indians were shown to have significantly lower physical activity than Caucasians (Chandalia et al., 2003). In a

study by Misra et al (2005) in the San Francisco Bay Area, among 56 healthy Asian Indians, 50% reported light or no leisure time activity.

In the U.K., a low level of physical activity has been widely documented among Asian Indian immigrants compared to the mainstream population (Fischbacher et al., 2004; Hayes et al., 2002). Kolt et al (2007) conducted a study with Asian Indian immigrants in New Zealand and based on the number of pedometer steps/ day; 48% and 33% of the Asian Indians were classified as sedentary and "low active", respectively. In a study in Britain, about 85% of 106 Asian Indian men with diabetes, did not show any interest in physical activity (Naeem, 2003). Therefore, promotion of physical activity might be a major consideration of treatment for this population (Carroll et al., 2002).

A few studies, in which a qualitative approach was used, documented the barriers to physical activity in this population (Lawton et al., 2006; Naeem, 2003). In the U.K., among thirty two Asian Indian and Pakistani individuals with diabetes, although all the participants were aware of the importance of physical activity, only seven practiced regular exercise. In this group, perceived/ reported key barriers to physical activity were lack of time and opportunity. More specifically, the pressure to work long hours and family obligations were mentioned as potential reasons for the lack of time (Lawton et al., 2006). The other most prominent reported barriers for physical activity were language for those who could not speak the language of the host country, absence of fellow Asian Indians in the community, lack of culturally sensitive facilities, decreased confidence

due to diabetes, and climatic conditions (Lawton et al., 2006; Naeem, 2003). Asian Indians also perceived that diabetes triggers an irreversible decline in their health that weakens their bodies and makes it difficult to exercise (Lawton et al., 2006). These barriers to physical activity should be taken into consideration when advising patients of South Asian origin.

2.3.3 Weight Management

Overweight or obesity is a major risk factor for type 2 diabetes and indeed for control and complications relative to the disease (Klein et al., 2004; Mokdad et al., 2003). Weight loss decreases insulin requirements and increases insulin sensitivity thereby improving glycemic control and overall health status (Wing, 1995). Even modest weight loss could benefit individuals with type 2 diabetes (Klein et al., 2004; Wing et al., 1987). A combination of behavior modification (increasing physical activity, monitoring caloric intake, separating eating from other activities, removing food cues from the environmemt, and eating slowly) has been shown to improve glycemic control in obese type 2 diabetes patients (Wing et al., 1991).

Compared to Caucasians and African Americans, Asian Indians have higher abdominal and truncal adiposity despite their lower BMI (Misra et al., 2004). Studies have documented an average BMI of 24 - 26 among immigrant Asian Indians in the U.S. (Chandalia et al., 2003; Chandalia et al., 1999; Jonnalagadda et al., 2002; Misra et al., 2009; Misra et al., 2005; Mohanty et al., 2005; Venkataraman et al., 2004), which is

classified as overweight (BMI ≥23 – 24.9) or obese (BMI ≥25) according to the WHO Asian Pacific guidelines (Inoue et al., 2000). Furthermore, based on the review of literature on metabolic syndrome among Asian Indians by Misra and colleagues (2004), the mean BMI is higher for Asian Indian immigrants (BMI 24.7) compared to Asian Indians in urban (BMI 22.4) and rural (BMI 19.6) India (Misra et al., 2004). The authors discussed urbanization/ emigration as influential factors for the increasing trend in BMI from rural to immigrant Asian Indians (Misra et al., 2004). These higher BMI values for immigrant Asian Indians, who are at risk for diabetes even at a relatively lower BMI, may further aggravate the disease risk.

The importance of weight status and control, and especially if at risk for or diagnosed with type 2 diabetes may sometimes not be perceived as a problem in Asian Indians. For e.g. in a study by Naeem (2003) in the U.K., 80% of Kashmiri immigrant men with diabetes were informed by a health professional that they were overweight, but half disagreed. This could be challenging for health care professionals, and necessitate appropriate strategies for trying to address the problem.

2.3.4 Medication Adherence

Medication is usually an important adjunct to diabetes management (oral hypoglycemic agents and/ or insulin injections). In addition, individuals with diabetes or other chronic diseases may need to take diabetes medications in conjunction with medications for other conditions such as high blood pressure, and coronary heart disease. The nature of the

treatment regimen, and a patient's perceptions about potential side effects and benefits of prescribed medications may influence compliance with prescribed medications (Rubin, 2005). In addition, patients' understanding about the essential self-management practices and provider communication about the treatment and medications have been shown to influence medication compliance (Heisler et al., 2002).

In a study among 151 patients with type 2 diabetes in New York, poor adherence to prescribed medications was evident in 30% of the participants (Mann et al., 2009). Patients' beliefs ("have diabetes only when blood sugar is high", "do not have to take medicine when the glucose is normal", "worrying about side-effects of diabetes medicines", "lack of self-confidence in controlling diabetes", and "expressed difficulty in taking medicines regularly") were predictors of poor medication adherence. Thus, patients' perceptions about medications and the severity of the disease may play an important role in compliance with prescribed medications.

Intensive insulin therapy for both type 1 and type 2 diabetes has been shown to delay the progression of complications associated with poorly controlled diabetes (Hayward et al., 1997; Ohkubo et al., 1995). Peyrot et al (2005), however, in a multi-national study documented that about 50% of general practitioners and nurses compared to specialists were more likely to delay insulin therapy for patients diagnosed with type 2 diabetes, especially when the provider awareness of the efficacy of insulin was low (Peyrot et al., 2005). Individuals with type 2 diabetes may also exhibit an aversion towards insulin

injection therapy, which is often associated with failure to adhere to other diabetes self-management practices by patients (Hayes et al., 2006; Larkin et al., 2008; Polonsky et al., 2005). On the other hand, some patients with type 2 diabetes, who are poorly controlled, have been shown to perceive insulin therapy as beneficial (Peyrot et al., 2005). Hence, patients' positive perceptions and attitudes about insulin therapy could influence patient satisfaction with insulin administration (Hayes et al., 2009). Therefore, health professionals and the patients should recognize the importance of insulin therapy when it is necessary and the therapeutic option should be clinically effective (Hayes et al., 2006).

2.3.5 Self-monitoring of Blood Glucose

Daily home blood glucose monitoring and quarterly HbA1c measures are two techniques suggested by the American Diabetes Association for the assessment of glycemic control (ADA, 2009). Self-monitoring blood glucose at home, which typically involves finger pricking, facilitates patient understanding of day to day variations in blood glucose and the evaluation of blood glucose response to diet and physical activity as well as to treatment (ADA, 2009).

Self-monitoring of blood glucose has been shown to benefit patients and improve glycemic control in patients with type 2 diabetes (Bode et al., 1999; Guerci et al., 2003; Karter et al., 2001). In addition, studies have shown regular monitoring of blood glucose to be associated with improved metabolic control and decreased diabetes-related morbidity among people with diabetes (Guerci et al., 2003; Martin et al., 2006). On the

other hand, low socioeconomic status of the neighborhood, old age, poor glycemic control, fewer physician consultations, and obesity were associated with lower rates of blood glucose monitoring in a cross-sectional study of 4,565 patients with type 2 diabetes in Massachusetts (Adams et al., 2003).

It is recommended by the ADA that individuals on insulin therapy should monitor their daily blood glucose level three or more times a day (ADA, 2009). However, data from the NHANES III show that only 40% of individuals on insulin therapy actually monitored their blood glucose at home (Harris, 2001). In addition, the NHANES III data indicated that only a small proportion patients treated by diet or oral medications (5-6%) self-monitored their blood glucose (Harris, 2001). Self-monitoring of blood glucose is a useful guide for therapy for patients. Regular monitoring of blood glucose by patients with type 2 diabetes who are treated with diet alone or diet plus oral medications has been shown to improve metabolic control in the Auto-surveillance Intervention Active (ASIA) study conducted in France (Guerci et al., 2003). Therefore, regardless of the type of treatment, self-monitoring of blood glucose may be beneficial for all individuals with diagnosed diabetes.

2.3.6 Foot Care

According to the North-West Diabetes Foot Care Study in England, each year about 2% of patients with diabetes develop new foot ulcers (Abbott et al., 2002). Adherence to proper foot care is essential for diabetes management given that 50% of all non-traumatic

lower limb amputations occur in people with diabetes (Most et al., 1983). The risk for lower extremity amputations is 15 times higher among individuals with diabetes than those without the disease, especially for those in poor glycemic control (Most et al., 1983).

Education about foot care and an annual comprehensive foot examination of foot pulses and sensations to detect potential causes of foot ulcers and amputations is recommended for all individuals with diagnosed diabetes (ADA, 2009). Besides foot care, adequate glycemic control is essential among diabetes patients with foot ulcers because poor glycemic control is an independent predictor of lower extremity amputations among people with diabetes (Davis et al., 2006). Moreover, the medical expenditures related to diabetes increases in the presence of foot ulcers (Davis et al., 2006). In a study conducted in India, the cost of management of the disease was shown to increase threefold when patients had foot problems related to diabetes (Shobhana et al., 2000).

When diabetes is tightly controlled the incidence of new lower extremity ulcers and amputations could be greatly reduced. In a longitudinal study of type 2 diabetes patients in India, 82% who strictly adhered to treatment advice had fewer new foot ulcers along with faster healing of the existing ones when compared to 50% in the non-adherent group (Viswanathan et al., 2005). Thus, patient adherence to recommended foot care practices may prevent additional medical expenses and complications that may lead to disability.

2.3.7 Medical Monitoring

Diabetes patients should receive health care from a team of health professionals that include physicians, nurse practitioners, dietitians, nurses, physician assistants, pharmacists, and mental health professionals with an expertise in diabetes (ADA, 2009). Regular consultation with a physician to monitor disease progress and annual consultations with specialists to screen for retinopathy and peripheral neuropathy is also recommended to prevent complications such as blindness and amputations, or even death (ADA, 2009). Four or more physician visits/ year have also been shown to improve the odds of self-monitoring of blood glucose by patients in a cross-sectional study of diabetes patients in Massachusetts (Adams et al., 2003).

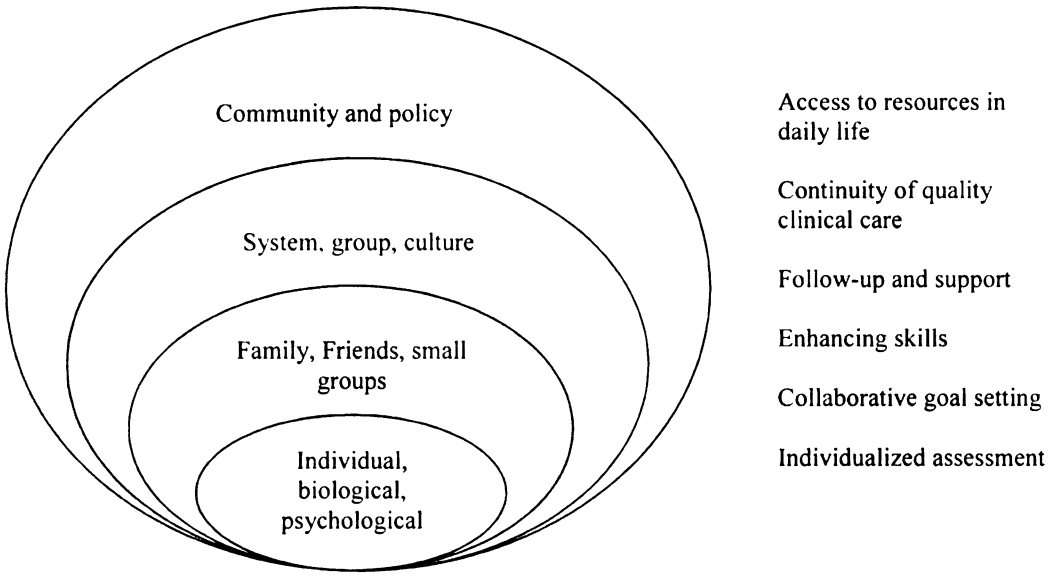
In a study by Heisler et al (2002), patients receiving diabetes care evaluated their satisfaction with their health care providers. Patient-provider communication (open discussion about the disease, informing the test results on a timely manner, and explaining treatment alternatives and medication side-effects) was shown to be significantly associated with the overall self-management by patients (Heisler et al., 2002). Difficulties in medication adherence and follow-up visits with the physician have been shown to be evident among diabetes patients with low treatment satisfaction (Biderman et al., 2009). Furthermore, the presence of diabetes-related complications such as foot ulcers have been shown to be related to decreased satisfaction with the treatment provided, which may affect the patients' compliance with medical monitoring of the disease (Biderman et al., 2009).

2.4 Theoretical Framework

This study was guided by two theories adapted for diabetes self-management: The Social Ecological Theory (Fisher et al., 2005) and The Enhance Behavior Performance model of the Self Efficacy Theory (Sousa et al., 2004). According to Fisher et al (2005) "an ecological approach to self-management integrates the skills and choices of individuals with services and support they receive from (1) the social environment of family, friends, worksites, organizations, and cultures; and (2) the physical and policy environments of neighborhoods, communities, and governments" (see figure 2.1).

Based on the ecological approach, Fisher and colleagues (2005) identified the following key resources and supports for self-management (RSSM) required by individuals: access to resources in daily life, continuity of quality clinical care, follow-up and support, enhancing skills, collaborative goal setting, and individualized assessment. The RSSM depicts the influence of social and environmental factors on diabetes self-management from the perspective of individual's needs (Fisher et al., 2005).

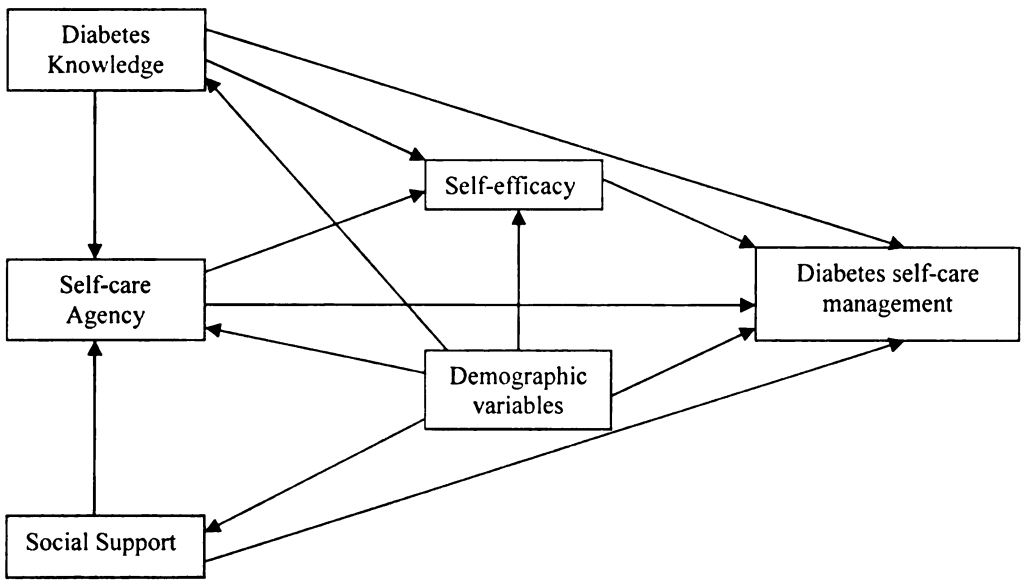
Figure 2.1 Social Ecological Theory: Correspondence of Ecological Levels of Influence with Resources and Supports for Self-management (Fisher et al., 2005).



On the other hand, The Enhance Behavior Performance Model (E-BPM) was developed from the Theory of Self-care and the Self-efficacy theory. A portion of the E-BPM was used to design the model for diabetes self-management, which proposes that personal (self-care agency (individuals' capabilities), self-efficacy (beliefs in ability), diabetes knowledge) and environmental factors (social support) influence an individual's performance of diabetes self-management behaviors (Fig 2.2). Based on this model for diabetes management, it is postulated that an individual with greater diabetes knowledge will have greater self-care agency and self-efficacy leading to improved diabetes self-management behaviors (Sousa et al., 2004). Likewise, social support from family and friends is believed to increase self-care agency thereby leading to improvement in

diabetes management behaviors, while self-care agency itself could lead to greater self-efficacy and better diabetes management behaviors (Sousa et al., 2004)

Figure 2.2 Research Model for Diabetes Self-care Management (Adapted from the Enhance-Behavior Performance Model) (Sousa et al., 2004).



2.5 Factors Influencing Diabetes Management

The present study employed the integrated model of ecological theory with the enhance behavior performance model for diabetes self-management as a guide to identify the factors that may influence self-management behaviors. Within the context of grounded theory as described in section 2.4., there could be several personal/ individual and environmental factors that may influence diabetes self-management behaviors. Asian

Indian immigrant relevant factors important for the present research study are subsequently discussed in this thesis.

2.5.1 Personal/ Individual Factors

Individual factors such as acculturation to the mainstream culture, educational level, income status, diabetes duration, knowledge about the disease, and individual values and beliefs are relevant to self-management of diabetes because of the fact that they could all influence behavior.

2.5.1.1 Acculturation

Culture is defined as "the collective programming of the mind which distinguishes the members of one group or category of people from another" (Hofstede, 1991). According to Berry (2005), when two or more cultures come into contact, psychological and cultural changes occur at individual and group levels termed acculturation. The Social Sciences Research Council (SSRC) in the U.S. defines acculturation as "culture change that is initiated by the conjunction of two or more autonomous cultural systems. Its dynamics can be seen as the selective adaptation of value systems, the process of integration and differentiation, the developmental sequences, and the operation of role determinants and personality factors" (SSRC, 1954). Immigrants to the U.S. may encounter challenges in adjusting to the language, behavior, values, and characteristics of the new culture and hence experience acculturative stress due to difficulties in adaptation (Berry, 2005).

Berry et al (1987) categorized the areas of difficulties as follows: physical (climate, shelter, population density, and pollution), biological (diet and diseases), social (friends and relationships), cultural (political, economic, linguistic, and religious) and psychological (attitudes, values and mental health).

Adaptation to a western dietary lifestyle especially with a decline in physical activity may contribute to the high prevalence of diabetes among immigrants to western countries (Abate et al., 2005; Zimmet et al., 2001). Studies conducted on various ethnic populations have shown that acculturation to the mainstream culture could result in negative health outcomes such as increasing rates of diabetes, obesity, hypertension, coronary artery disease risk, and poor dietary quality (Aldrich et al., 2000; Dixon et al., 2000; Himmelgreen et al., 2004; Hubert et al., 2005; Kaplan et al., 2002; Lands et al., 1990; Marmot et al., 1976). On the other hand as acculturation increased, the risk for obesity decreased in Mexican American women in the San Antonio, Texas study (Hazuda et al., 1991). Similarly, decreased acculturation was associated with increased risk for diabetes in Arab immigrants in the U.S. (Jaber et al., 2003). Therefore, acculturation in relation to disease management may not be the same across different ethnicity.

Due to their century old immigration status, acculturation, and adaptation patterns of Asian Indians is still being researched by social scientists. Information documented thus far indicates that the tendency to acculturate and for bi-cultural functioning is quite common for Asian Indians because of their prior experience with British colonialization

for several years (Ibrahim et al., 1997; Kurian et al., 1983; Saran, 1985; Wakil et al., 1981; Williams, 1998). Their English fluency and prior exposure to western values (Leonard-Sparks et al., 1980) may facilitate the acculturation process in this population. However, religious and linguistic identity, family values, and close family ties are very important in the Asian Indian culture (Williams, 1998) and therefore, Asian Indians also have a tendency to retain their heritage values, beliefs, and traditions after immigration (Patel et al., 1996; Wakil et al., 1981; Williams, 1998).

Typically, Asian Indians immigrants maintain the association with their heritage culture by making frequent visits to the home country and by being a part of various Asian Indian social networks (Dasgupta, 1998). In such forms, Asian Indians in the U.S. exhibit a pattern of psychological closeness to their heritage culture, which Dasgupta (1998) describes as "reinventing Indian culture on a foreign soil." Furthermore, Asian Indian immigrants have shown to value their traditions and customs even more than their Indian counterparts (Mehta et al., 1991). In other words, although Asian Indian immigrants conform to the host culture and are integrated at the social level (clothing, language, and housing), many appear to retain their Asian Indian culture within their family environment (marriage and ethnic identity) (Mehta et al., 1991).

Socio-demographic characteristics are important determinants of the degree of acculturation. Higher educational level, employment status, and socioeconomic status have been shown to facilitate the acculturation process (Cheung et al., 1995; Ghuman,

2000). The adaptation to a new culture could be different and faster for Asian Indian males than females as Asian Indian males have been reported to enjoy more independence and educational opportunities than females (Ghuman, 1997; Wakil, 1981). Likewise, younger individuals tend to have a higher degree of acculturation than older individuals (Cheung et al., 1995). Generational status (more recent vs. first generation) (Varghese et al., 2007) and longer duration of stay in the host country (Cheung et al., 1995) have also been shown to favor the process of acculturation.

While the degree of acculturation may differ across different religious groups (Ghuman, 2000; Sonuga-Barke et al., 2000), immigrants with a strong ethnic identity have been shown to have firm religious beliefs (Greeley et al., 1999). India is a multi-religious country, with Hinduism the predominant religion followed by the majority (80%) of its people. While urbanization in India has led to a decline in many of the original religious practices (Mullatti, 1995), Asian Indians in the U.S., however, have tended to be more religiously active after immigration (Williams, 1988). Religious groups give a group identity and serve as a place for Asian Indians to feel "at home outside their home," thus allowing more freedom of expression about cultural values within their group (Williams, 1988).

Misra et al (2004) reviewed articles related to obesity, metabolic disorders, and impaired insulin mechanism among Asian Indians and summarized the differences in average values of the common indicators of obesity between Asian Indians in India and Asian

Indian immigrants to other countries (see Table 2.6). Based on the study findings, it is evident that Asian Indians who immigrate to other countries have higher BMI and body fat than their counterparts in India, which could partly be due to adoption of the lifestyle of the host culture. Consistent with this review, Mooteri et al (2004) documented a positive association between longer duration of residence in the U.S. and increased risk for coronary artery disease among first generation Asian Indians.

Table 2.6 Average values of various measures of obesity in Asian Indians (Misra et al., 2004).

Parameters	Location of residence of Asian Indians			
	Rural India	Urban Slums of India	Urban India	Immigrants
Body Mass Index (Kg/m^2)	19.6 (3674)	20.9 (674)	22.4 (111,722)	24.7 (7686)
Percentage of body fat	20.4 (149)	24.4 (674)	28.2 (273)	33.1 (107)
Waist circumference (cm)	79.4 (149)	83.7 (142)	85.2 (273)	83.7 (1837)
Waist-to-hip ratio	.87 (3674)	.92 (142)	.87 (12,124)	.92 (7686)

Despite the striking differences in the markers of chronic diseases as depicted in Table 2.6, there is no study of acculturation and diabetes control or management of Asian Indians in the U.S. However, there are a few studies that focused on acculturation/ duration of stay in the U.S. and dietary patterns of Asian Indians. The findings of these studies showed that acculturation of Asian Indians was associated with frequent selection of western foods and replacement of traditional foods with other ethnic or western foods (ADA, 2000). Increased consumption of alcohol, whole grain foods, fish, poultry, meat, salty snacks and desserts were noted (ADA, 2000). However, other studies have shown the diet of Asian Indians in the U.S. to be deficient in dietary fiber (Jonnalagadda et al.,

2002), but a longer duration of stay was associated with decreased consumption of saturated fats (Raj et al., 1999). Therefore, acculturation may play a substantial role in diabetes management by impacting the dietary behaviors of Asian Indians and perhaps environmental and lifestyle changes after immigration may influence their level of physical activity as well.

2.5.1.2 Educational Level

Lower educational level (<12 years of education) has been shown to be associated with increased risk for type 2 diabetes (Maty et al., 2005). According to the data from the National Health Interview Survey (NHIS) 1997 – 2002, individuals with lower educational attainment (less than a high school diploma) were more likely (1.6 times) to have diabetes than to those with at least a college degree (Borrell et al., 2006).

In addition, Miech et al (2009) calculated diabetes-related mortality rates using the U.S. Vital Statistics and the U.S. Census data, and examined the trends in diabetes prevalence and glycemic control across different educational levels using the NHANES data sets 1988-1994 and 1999-2004. The study documented an increasing trend in diabetes-related mortality rates with decreasing educational level. Diabetes-related mortality was the least among individuals with a college degree or more, at all the four time points included in the study (1989, 1995, 2000, and 2005). There was also a decrease in the prevalence of diabetes-related mortality from 1989 to 2005 for the group that had college degree, while

the prevalence increased for all other categories of educational levels (low education, high school, and any college) (Miech et al., 2009).

Therefore, self-management and control and hence associated complications of the disease may be associated with educational status. Additionally, Biderman et al (2009) showed treatment satisfaction (assessed by the type of medical care, proximity to clinic, routine diabetic nurse care, laboratory tests, and the type of treatment) be significantly lower among patients who had ≤ 6 years of education than those with > 6 years. Chilton et al (2006) observed a significant association between education level and diabetes knowledge of Hispanic adults. In this study, individuals with at least a high school education had a better understanding of the disease and self-management behaviors than those who did not (Chilton et al., 2006). Therefore, education may directly affect the diabetes knowledge of patients and potentially indirectly impact their glycemic control. Consistent with this finding, in The Los Angeles Latino Eye Study (LALES), type 2 diabetes patients with lower educational levels were more likely to be non-compliers of ADA eye care recommendations (Paz et al., 2006). This was confirmed by Miech et al (2009), who showed a decrease in the prevalence of diabetes and a relatively lower HbA1c levels among those with a higher education in the NHANES data (Miech et al., 2009).

2.5.1.3 Income Status

Diabetes has been shown to disproportionately affect populations of low income status (Cuasay et al., 2001; Martinez et al., 2007; Rabi et al., 2006). Higher income status may facilitate health promotion activities, quality of health care and facilities and health outcomes among individuals with diabetes (Guimaraes et al., 2009; Kwan et al., 2008; Levine et al., 2009).

Individuals with low socioeconomic status may not be eligible for health insurance coverage and quality medical services, which will likely increase the burden of the disease and related complications (Baker et al., 2000). According to data from the National Access to Care Survey, individuals without health insurance coverage were less likely to receive medical care when compared to insured individuals (p=.001) (Baker et al., 2000). In a study among patients with type 2 diabetes in San Diego, absence of health insurance significantly predicted poor glycemic control (Benoit et al., 2005), which was evidenced by a higher mean HbA1c levels among participants who did not have health insurance coverage (Benoit et al., 2005). In addition to glycemic control, low-income status has been shown to affect diabetes self-management behaviors such as reduced self-monitoring of blood glucose, medication adherence, and avoidance of healthy foods due to the perceived high cost (Kwan et al., 2008). Therefore, income status is an important consideration, which cannot be omitted in studies addressing diabetes self-management and control.

2.5.1.4 Family History of Diabetes

A positive family history of diabetes is a significant predictor of the disease in Asian Indians (Ramachandran et al., 2001; Venkataraman et al., 2004), with reported increased risk especially when both parents have diabetes (Knowler et al., 1981). Individuals who have a positive family history of diabetes overall are two to six times more prone to be affected with the disease than those who do not (Harrison et al., 2003). In a study by Venkataraman et al (2004), among Asian Indian immigrants to the U.S., 53% with diagnosed diabetes had a family history of diabetes. In this study, family history was the strongest predictor of diabetes (OR: 6.0; 95%CI: 4.2 – 8.4). Awareness about diabetes, the inquisitiveness to learn about the disease, and engagement in health promotion activities may increase if a family member is affected with the disease (Baptiste-Roberts et al., 2007). Therefore, individuals with one or more family members with diabetes will have prior exposure to the characteristics of the disease and the self-management behaviors, which in turn may have an impact on self-management of the disease.

2.5.1.5 Duration of Diabetes

Studies that have analyzed the relationship of duration of diabetes with glycemic control have shown a negative association between the two. In a cross-sectional analysis of the 1990 – 1991 Michigan Diabetes in Communities II study, a longer duration of diabetes increased the likelihood of poorer control (Blaum et al., 1997). Similarly, in a longitudinal study of type 2 diabetes patients in the Project Dulce program in San Diego,

the longer the duration of diabetes the poorer was the glycemic control of participants (Benoit et al., 2005).

On the other hand, besides improving glycemic control, shorter duration of diabetes (< 2 vs. > 2 years) has been shown to be associated with better dietary and physical activity behaviors of type 2 diabetes patients, who participated in a diabetes education program in the Southwest (Parchman et al., 2003). Disease progression and complications could be important factors that have contributed to duration of diabetes being an influencing factor of diabetes management and control. Susceptibility to diabetes-related complications has been shown to be significantly positively associated with disease duration (Roberts et al., 2008). As repeatedly explained previously, the connection between appropriate self-management and disease control cannot be overemphasized.

2.5.1.6 Diabetes Knowledge

Knowledge about diabetes has been shown to enhance understanding of the disease and related complications and facilitate glycemic control among Asian Indians (Panja et al., 2005; Iqbal et al., 2008). Awareness about the disease is especially important for high risk populations like the Asian Indian to take preventive measures such as screening and early detection of the disease. However, the awareness about diabetes self-management behaviors was found to be poor among subjects with diabetes in India (Murugesan et al., 2007). In the U.K., Asian Indians were less aware of the long term complications of diabetes (Macaden, 2007) and had significantly lower diabetes knowledge than the local

white population (Baradaran et al., 2004). Although there is no documented evidence in the U.S., culture specific education may improve diabetes knowledge and glycemic control as documented by Hawthorne (2001) among Pakistani women living in Britain.

2.5.1.7 Values and Beliefs

Besides the other individual factors discussed, the beliefs of an individual and how he/ she values certain practices should not be ignored as they may impact ability to practice self-management behaviors by the individual. Hjelm et al (1999) emphasized individual care for diabetes patients with recognition of immigrant patients' beliefs, experiences pertaining to immigration, knowledge level, and health care staff expectations. In their study of Yugoslavian and Swedish females with diabetes in Sweden, cultural differences in beliefs about diabetes and self-management, which includes the use of complementary and alternative medicines, were evident (Hjelm et al., 1999). India has a rich history of complementary and alternative medicine usage. Therefore, it is not uncommon for Asian Indians to follow traditional therapies. However, some of the non-prescription medications such as folk medicines ingested by immigrant Asian Indians have been shown to induce serious adverse side effects (Pontifex et al., 1985).

In addition, cultural differences may exist in beliefs of individuals about foods related to diabetes management. Several traditional plant foods have been shown to be consumed by Asian Indian immigrants due to their perceived medicinal properties, especially the foods related to diabetes prevention and control (Pieroni et al., 2007). In a study

conducted by Baradaran and colleagues (2004) in Glasgow, several plant/ food remedies, homeopathic medicines, and a few unknown medicines were used for diabetes management by Asian Indians and Pakistanis. For example, plant derivatives such as bitter melon (*Momordica charantia*), ivy gourd (*Coccinia indica)* and fenugreek seeds (*Trigonella foenum graecum*) were reported to be widely used as home remedies for type 2 diabetes in the Asian Indian population. These plant derivatives, believed to contain antidiabetic properties, have been shown to induce a hypoglycemic effect and improve glycemic control if used consistently for several weeks (Krawinkel et al., 2006; Kurpad et al., 2008; Sharma et al., 1996). However, more research is needed before adjunctive use of food remedies, as certain adverse effects such as headaches and hypoglycemic coma and convulsions in children may occur due to their potential toxic components (Basch et al., 2003; Krawinkel et al., 2006).

Religious beliefs are highly valued in the Asian Indian community, which affects their dietary patterns because there are different dietary codes and laws for each religion (Kulkarni, 2004). Previous studies have shown that South Asians in general perceived diabetes to be a disease determined by God, which demonstrates the perceived association between religion and health by people of this ethnicity (Lawton et al., 2006; Naeem, 2003). Strict and prolonged fasting during religious occasions is performed by many Asian Indians even when diagnosed with compromised health conditions such as diabetes (Naeem, 2003). Diabetes is not considered by many as sufficiently serious to

exempt individuals from religious fasting (Tripp-Reimer et al., 2001). This might have serious metabolic ramifications e.g. hypoglycemia.

2.5.2 Environmental Factors

The environmental factors that may potentially determine the diabetes self-management behaviors of individuals are: health care system (facilities and providers); support from social networks such as family, friends, and community; and location of residence and neighborhood characteristics.

2.5.2.1 Health Care System

Patient and health care provider relationship is critical for open communication about the disease, clinical recommendations, and challenges which a patient may face. Improved glycemic outcomes have been documented in conditions where the patient and health care provider share a good relationship (Aikens et al., 2005). In a study by Heisler et al (2002), provider communication was also shown to be significantly associated with the overall self-management by patients with type 2 diabetes. Participants of this study perceived that the guidance provided by the physician (information about the disease, medications, and treatment options) were more important than the patient's participation in making treatment decisions. Thus, patient-provider relationship is important for better communication between the patient and the health care professional and possibly adherence to treatment recommendations.

Culture is often perceived as a barrier to a more favorable patient-health care professional communication, which could be addressed by using cultural assessment (Tripp-Reimer et al., 2001). "A cultural assessment is a focused and systematic appraisal of beliefs, values, and practices conducted to determine the context and substance of client needs, and then to best adapt (or construct) and evaluate health interventions" (Tripp-Reimer et al., 2001). For example, health care professionals should question patients about their dietary practices and food preferences, before providing culturally appropriate dietary recommendations for diabetes management (Kulkarni, 2004). Involvement of the patient's family members and a dietitian would facilitate selection of appropriate foods that are beneficial and acceptable to the patient (Kulkarni, 2004).

Besides the physician, other health care professionals should work collaboratively with the primary care physicians to facilitate tight glycemic control in people with diabetes. A study by Aubert et al (1998) randomized people with diabetes into a "usual care" (regular care) and a "nurse care" group keeping all other conditions such as medication type, dosage, body weight, and blood pressure the same for both groups. The study documented a 1.7% decrease in HbA1c value in the group that received the nurse care versus 0.6% in the usual care.

In a study among patients of Kaiser Permanente's Pleasanton, CA facility, subjects with poorly controlled diabetes (HbA1c>8.5%) were randomly assigned into control and intervention groups (Sadur et al., 1999). The intervention group received

multidisciplinary outpatient diabetes care, which included a psychologist, a diabetes nurse educator, a nutritionist, and a pharmacist for six months. The HbA1c level of participants in the intervention group significantly declined by 1.3% ($p<.001$) with patients demonstrating improved self-management practices and self-efficacy (Sadur et al., 1999). Thus, as suggested by the ADA (2009), a multidisciplinary approach in treating diabetes patients by a team of health professionals with expertise in diabetes is warranted.

2.5.2.2 Social Support

Social support from friends, family, and the community is critical for people living with chronic diseases such as diabetes. Several studies conducted on different populations have shown the beneficial effect of social support in relation to diabetes self-management behaviors such as adherence to healthy diet, medications, and exercise (Lloyd et al., 1993; Pham et al., 1996; Sousa et al., 2004). Furthermore, the risk for mortality has been shown to be 55% lower among elderly diabetes patients with high social support, which includes support from friends, neighbors, and relatives (Zhang et al., 2007).

In general, immigrants to the U.S. have been shown to have stronger social support from friends and family (Frisbie et al., 2001). In this respect, Asian Indians in the U.S. were shown to have good social support and strong interpersonal relationships in a study by Misra et al (2000) that documented the health promotion activities of Guajarati Asian Indians in Atlanta, GA. However, other than close family members, social support

received by Asian Indian immigrants may not be comparable to that received from parents and extended family members in the home country (Kalra et al., 2004).

The role played by social support in diabetes management of Asian Indians is well documented in the U.K. In a study conducted in the U.K., strong social networks were perceived as resources by Asian Indians with diabetes for emotional support (sharing diabetes experiences with peers) and empowerment through knowledge (relatives who had the disease served as sources of knowledge about diabetes) (Stone et al., 2005). Likewise, availability of support from trained diabetes support workers of the same ethnicity may have a positive influence on patient disease management. In the U.K., South Asian community members were recruited and trained as diabetes support workers to work with South Asian diabetes patients (Curtis et al., 2003). Consultation with South Asian diabetes workers was perceived as helpful in the feedback provided by health care professionals and diabetes patients (Curtis et al., 2003). Furthermore, being friendly and encouraging two-way communication, by fluency in the native language of patients were important aspects mentioned in the feedback. These could be important cultural barriers for disease management at the health care provider/ community level (Curtis et al., 2003).

2.5.2.3 Location of Residence

Neighborhood characteristics have been shown to influence the health behaviors of individuals living in the area (Cohen et al., 2003; Ross, 2000). Social structure and economic disparities in a neighborhood have been shown to affect health behaviors

(Elliott, 2000; Stead et al., 2001). More specifically, in a study by Shaw et al (2006) conducted in patients with diabetes, diet, physical activity and foot care were enhanced with neighborhood resource support. On the other hand, Franzini et al (2005), who studied low-income neighborhoods in Texas showed that neighborhoods that were unsafe and disordered, exhibited poor social support and physical activity behaviors.

Low-income neighborhoods may not have sufficient access to supermarkets with a variety of healthy food choices, but may offer options for promotion of unhealthy behaviors such as alcoholic beverages (Morland et al., 2002). Likewise, fear and stress associated with living in neighborhoods with high crime rates could aggravate the situation via restricted outdoor activities (Gordon-Larsen et al., 2000; Ross et al., 2001), while neighborhoods with sidewalks and scenic views have been shown to promote physical activity (Brownson et al., 2001). Location of residence could therefore be a critical factor relative to diabetes self-management especially from the availability of resources perspective.

CHAPTER 3

METHODS

This section includes a description of the two phase study design and detailed explanation of the procedures. Phase I is the validation of the interview guide using expert opinion and a pilot study. Phase II is the actual study conducted in five steps using a validated interview guide. The approval for this study was obtained from the Institutional Review Board at Michigan State University (MSU IRB) (Appendix A).

3.1 Design

This was a cross sectional exploratory study that employed mixed methodology by triangulating data obtained from qualitative and quantitative approaches with a convenience sample of Asian Indian adults with physician diagnosed diabetes in the acceptable (AC) (HbA1c<7%) and unacceptable (UC) (HbA1c≥7%) glycemic control groups. An acculturation instrument and a socio-demographic and self-care survey were used to collect quantitative data. A qualitative approach, using semi-structured in-depth interviews, was used to document the effects of acculturation and lifestyle factors related to self-management of diabetes.

3.2 Subjects and Recruitment

The study subjects were recruited from Indian organizations, stores and restaurants that are frequently visited/ contacted by Asian Indians in Michigan. Five clinic physicians, who treated a sizeable number of Asian Indians, also agreed to post the recruitment flyer

(Appendix B) of this study to attract the attention of potential participants. In addition, participants were also recruited through a snowballing method i.e. participants contacted potential study participants and informed them about the study. Participants were recruited and interviews were conducted until qualitative data saturation. Half of the participants were in the AC and half in the UC group. An attempt was made to have age and gender matched equal numbers of subjects in the AC and UC groups.

3.3 Eligibility Criteria

Eligibility for participation included: (i) physician diagnosed diabetes, (ii) age $\geq$ 18 years, (iii) Asian Indian descent, (iv) non-institutionalized, (v) ability to read and converse in English, (vi) not Pregnant/ lactating, (vii) most recent hemoglobin A1C (HbA1c) measured within the past twelve months, and (viii) resident in the U.S. for at least one consecutive year.

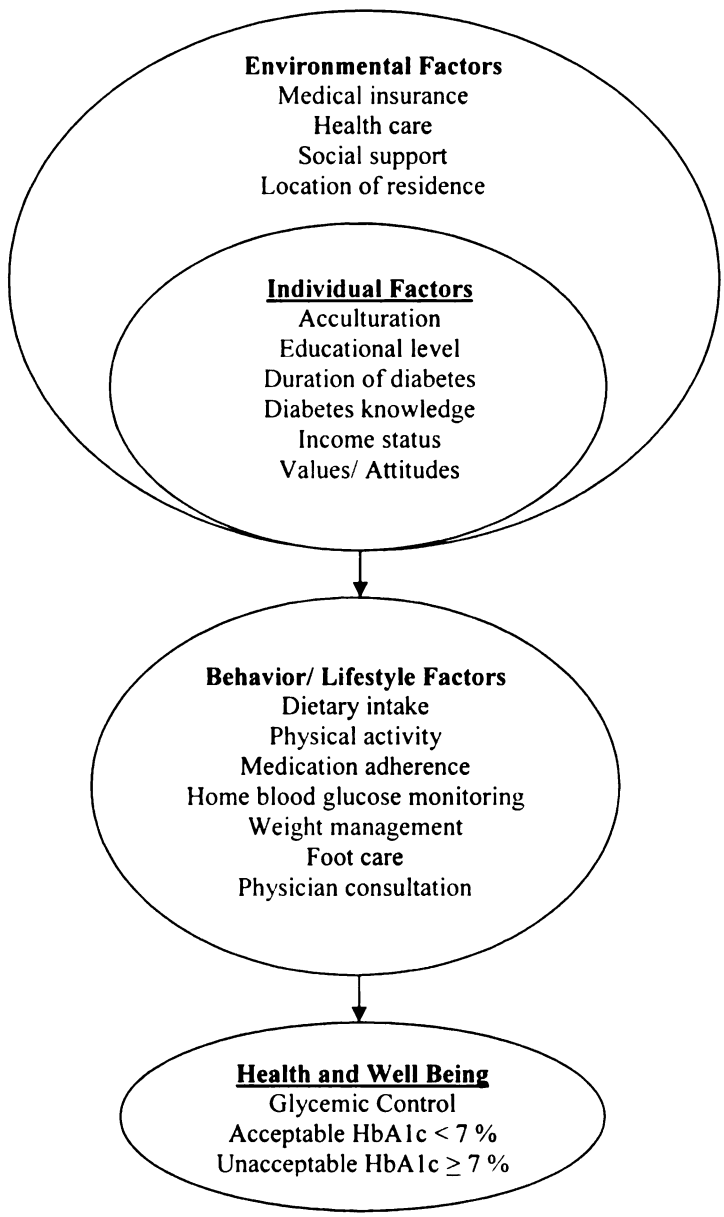
3.4 Procedures

3.4.1 Theoretical Foundation

The pertinent variables as identified in the literature were included in an integration (Fig 3.1) of The Social Ecological Theory (Fisher et al., 2005) and The Enhance Behavior Performance model of the Self Efficacy Theory (Sousa et al., 2004). Based on this model, key individual (acculturation, educational level, duration of diabetes, diabetes knowledge, income status, and personal values/ attitudes) and environmental (medical insurance,

health care, social support, location of residence) components that could potentially influence diabetes self-management behaviors were assessed in this study.

Figure.3.1 Integration of the Social Ecological Model with the Enhance Behavior Performance Model for Diabetes Self-Management (Fisher et al., 2005; Sousa et al., 2004).



3.4.2 Methods

Prior to conducting this study, Indian organizations were contacted to determine interest in co-operation and hence feasibility. Letters of support (Appendix C) were obtained from the organizations to provide permission to post flyers at their facilities, use their email listservs, and attend events for personal recruitment. An electronic version of the same flyer was also circulated as an email attachment via listservs provided by the organizations for members. The study was conducted in two phases described in summary in Fig 3.2.

Phase I included validation of an interview guide. Three nutrition/endocrinology experts of Asian Indian origin reviewed the interview guide (Appendix D) for face validity and a pilot study of four initial interviews was conducted (described in detail in section 3.6.3). The comprehensive five step procedures of the actual study (Phase II) were also followed in this pilot study to determine respondent burden and feasibility. Since there were no contextual changes made to the interview guide, and answers to the modified questions were provided by the pilot subjects, the data collected in the pilot study was also included in the final sample. Phase II was conducted in five steps:

(i) The investigator contacted interested participants and conducted a preliminary interview (Appendix E) by phone to determine eligibility for participation.

(ii) Eligible participants were invited to participate in this study and the interview site (own home or other mutually agreed upon location) was determined based

on the convenience of the participant. The participants signed a consent form (Appendix F) and a copy of their HbA1c laboratory test value was requested and obtained from the participant.

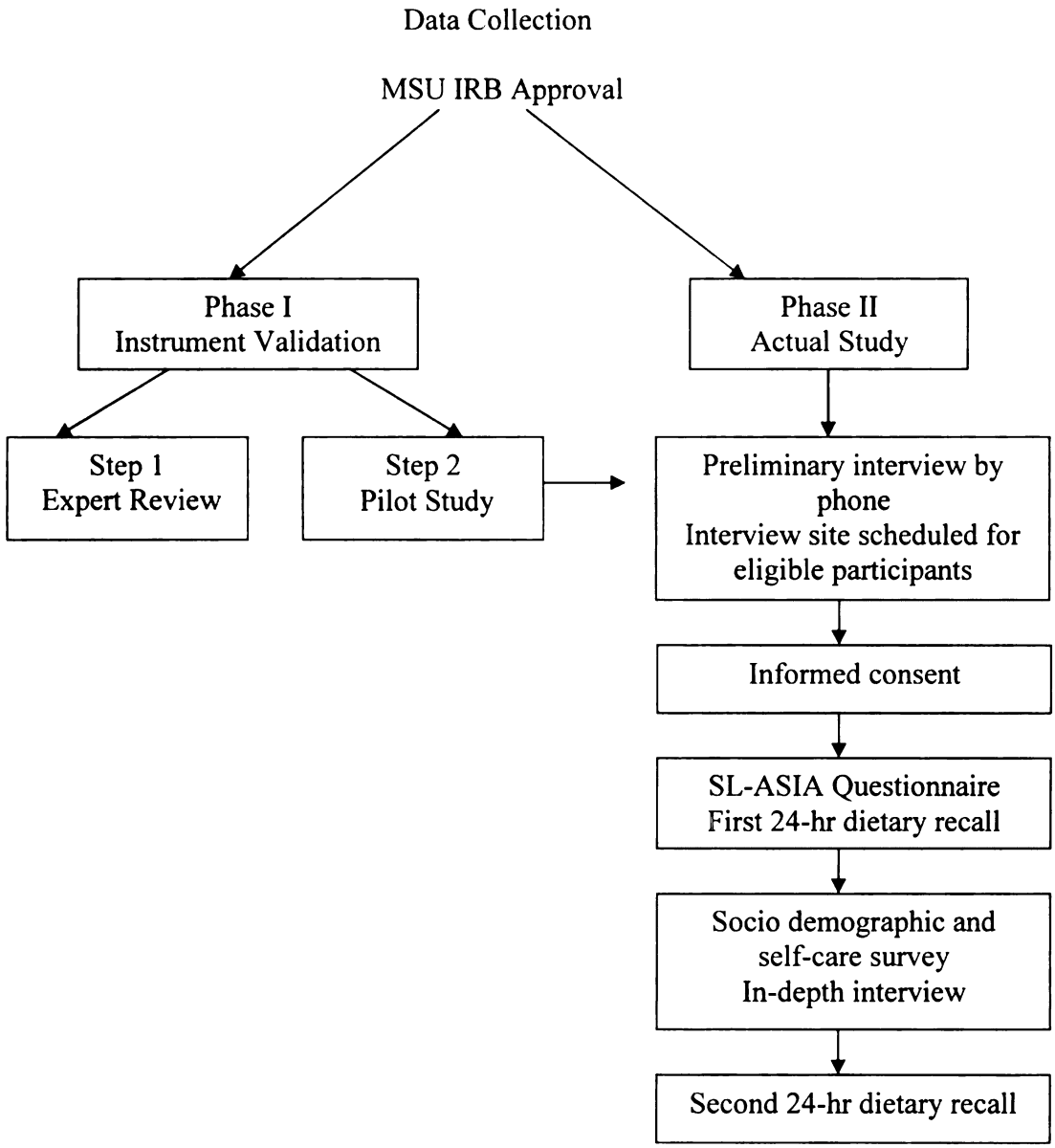
(iii) An acculturation instrument specific for Asians (SL-ASIA) and adapted for Asian Indians (Appendix G) was administered by the investigator to assess the acculturation level of the participants towards mainstream U.S. culture. An initial 24-hour dietary recall (Appendix H) followed immediately, also administered by the investigator. The two instruments took approximately 45 minutes to complete.

(iv) An in-depth interview, which lasted approximately one hour was then conducted. The interview consisted of an audio-taped socio-demographic and self-care survey followed by open-ended questions regarding diabetes self-management.

(v) Participants were subsequently contacted by phone on another day for an additional 24-hour dietary recall. The second dietary recall was collected for a week day or a weekend day depending on the day of the initial recall. This step took about 20 to 30 minutes to complete.

Upon completion of the in-depth interview and the second 24-hour recall, the participants received a $25 gift card to a local grocery store, as an incentive for participation.

Figure 3.2 Data Collection Sequence for the Two Phases of the Study.



3.5 Instruments

3.5.1 Suinn-Lew Asian Self-Identity Acculturation Scale (SL-ASIA)

Acculturation was measured using the Suinn-Lew Asian Self-Identity Acculturation instrument (SL-ASIA), which has been widely administered to Asians to describe their level of acculturation (Suinn et al., 1987). The SL-ASIA, which measures acculturation in a linear fashion, is based on the concept that increased adaptation to the host culture decreases the likelihood of retaining the heritage culture (Suinn et al., 1987). The Acculturation Rating Scale for Mexican Americans (ARSMA) was originally used as a model to develop the SL-ASIA instrument (Ceullar et al., 1980; Suinn et al., 1987).

The initial SL-ASIA instrument, which was used in this study, is unidimensional and consists of 21 items that include four items each on language, identity, and friendship choice, five items on behaviors, three items on generational background, and one on attitudes (Suinn et al., 1992). The instrument measures the degree of acculturation with Asian culture at one end and the host culture at the other and takes approximately 15 minutes to complete. The responses to the 21 items are added and then divided by the number of items. The scores are reflective of the acculturation level of the participants as follows: 5.00 is the highest possible value and indicates high acculturation or more westernization and a score of 1.00 is the lowest possible value indicating low acculturation or high orientation towards their heritage culture. A score of 3.00 is the midpoint of the scale and is typical of bicultural individuals.

The reliability and validity of the instrument were reported using the initial validation study with 82 Asian students in the U.S., followed by a concurrent and factorial validation using 324 Asian American university students (Suinn et al., 1992; Suinn et al., 1987). The scale had an alpha coefficient of 0.88 on the 21 items in the initial study (Suinn et al., 1987) and 0.91 in the follow-up (Suinn et al., 1992), which is indicative of a good internal consistency among the items of the instrument. Other studies using this instrument have reported consistent results, with coefficients of internal consistency of the items ranging from 0.68 to 0.88 (Ponterotto et al., 1998).

The validation of the SL-ASIA instrument was based on two criteria, generational differences and duration of stay in the host country. The lowest acculturation was observed in the first generation and in those with a minimum duration of stay in the U.S. The highest acculturation was found in the most recent generation and those with the longest stay in the U.S (Suinn et al, 1987). Exploratory factor analysis identified five factors that were influential: (i) reading/ writing/ cultural preference, (ii) ethnic interaction, (iii) affinity for ethnic identity and pride, (iv) generational identity, and (v) food preference (Suinn et al, 1992).

A cross-cultural examination of acculturation in Asians was done using this instrument between Asian Americans in the U.S. and Asian individuals in Singapore (Suinn et al, 1995). The results further supported the instrument to be a valid measure, as Asian Americans scored more on the acculturation scale than Singapore Asians, which is

indicative of higher acculturation (Suinn et al, 1995). Since the initial and concurrent validation was done using an Asian student sample, Ownbey et al (1998) tested the instrument for its reliability and validity using non-student Asian Americans. The study yielded a Cronbach's alpha value of 0.89, which suggests that the SL-ASIA was a good measure of acculturation even in non-student Asian Americans (Ownbey et al., 1998).

For the purpose of this research, all the relevant wording on the instrument which referred to "Asians" was modified to "Asian Indian" to be able to administer it to Asian Indians with the approval of Dr. Suinn (Personal communication, 2007). The modification was done independently by two researchers of Asian Indian descent and compared for consistency. Furthermore, the SL-ASIA instrument was also compared to the ARSMA by the two Asian Indian researchers. Each researcher completed the ARSMA and SL-ASIA separately, and when the two scores were compared, the acculturation levels measured by the two instruments were consistent. This provided support for the appropriateness of the use of the instrument to describe the acculturation level of Asian Indians.

3.5.2 Twenty Four-Hour Dietary Recall

Dietary data were obtained by two 24-hour dietary recalls to compare nutrient intake, frequency of meals/snacks, and the intake of food supplements of participants between the glycemic control and acculturation groups. The recalls were administered by the interviewer; one at the time of interview and the second one by phone within a week. The

interviewer was the primary researcher who was trained to use the validated USDA multiple pass method (Conway et al, 2003; Jonnalagadda et al, 2000). The procedure took approximately 20-30 minutes to complete, and the participants were informed about what the assessment would entail at the time of consent as well as prior to the recalls being conducted.

A quick list of foods and beverages consumed within the prior 24-hour period was first collected. The interviewer used probes for foods forgotten during the quick list with open-ended questions and mention of frequently missed foods. Mealtime and eating occasions for each food were collected and reviewed with the participant. Detailed descriptions of the foods and their preparation and serving methods with portion sizes were obtained. The participants were asked if the day recalled was a typical day pertaining to eating habits. Any dietary supplements, vitamins/minerals or herbal/ home remedies were recorded and the interviewer used a final probe for anything else that was consumed and double checked for incomplete items. It is recommended that dietary recalls not be consecutive and represent a week day and a weekend day to account for variability. Therefore, the recalls were for one week day and the other was for a weekend day. The second dietary recall was conducted based on the day of the initial recall by phone within a week.

Table 3.1 Research Objectives, Research Questions, and Corresponding Interview Questions.

Research Objectives	Research Questions	Interview Items/Questions
1. To describe and contrast self-management behaviors and related factors of Asian Indian adults with physician diagnosed type 2 diabetes, and who are either in acceptable (HbA1c <7%) or unacceptable glycemic control (HbA1c ≥7%)	How do participants perceive the impact of the disease and the required self-management behaviors?	• Can you tell me how having diabetes has changed your life? What do you do differently now? *Prompt: After being diagnosed with diabetes how has your daily routine changed?* • What do you do on a daily basis to take care of your diabetes? How do you feel about it? *Prompt: Exercise, medical care, diet, testing blood sugar, foot care etc.*
	How does the participants' knowledge of diabetes affect their self-management behaviors?	• Can you tell me what diabetes is? *Prompt: Tell me anything you know about diabetes?* • What do you think will happen if you do not take care of your diabetes? Why? • What do you think are the benefits of managing your diabetes? Why? • What do you think is important to take care of your diabetes? *Prompt: How did you learn this information?* • What do you think the role of medicine is in managing diabetes? • What do you think the role of food is in managing diabetes? • What do you think the role of exercise or physical activity is in managing diabetes? • You told me about the roles of food, medicine, and exercise, do you think one is more important than the other? How?
	How does location of residence influence self-management behaviors?	• Can you tell me about the area neighborhood where you live? Are there many Indians nearby? *Prompt: Are they friendly, helpful?* • Can you tell me how the place where you live helps you manage your diabetes? *Prompt: For e.g., access to health care, physical activity, diet, friends etc.* • Can you tell me how the place where you live prevents you from managing your diabetes? *Prompt: For e.g., Access to health care, physical activity, diet, friends etc.*
	How does the health care system influence self-management behaviors?	• What do you feel about the health care that you receive from your clinic or doctor? *Prompt: What do you like or dislike? Why?* • What do you think the role of doctor should be in helping you with your diabetes?

Table 3.1 Research Objectives, Research Questions, and Corresponding Interview Questions (cont.).

Research Objectives	Research Questions	Interview Items/Questions
1. To describe and contrast self-management behaviors of Asian Indian adults with physician diagnosed type 2 diabetes and who are either in acceptable (HbA1c <7%) or unacceptable glycemic control (HbA1c ≥7%)	In what ways are support networks and self-management related?	• When you first found out you had diabetes, who was the most helpful and how? *Prompt: family, friends, doctor etc* • How did your family respond or react when you first told them that you had diabetes? *Prompt – Can you give me an example? Were they supportive of it? Did they help in your diabetes management? If so, how?* • When you need help with your diabetes, to whom do you go to and how do they respond? *Prompt –Friends, family, doctor* • If you have relatives or friends with diabetes, how do you think having diabetes is the same or different for you compared to your family member or friend with diabetes? *Prompt: Can you give me some examples?*
	How does an individual's values and beliefs influence self-management behaviors?	• Can you tell me if you manage your diabetes with any other Indian treatments such as Ayurveda, Unani, Siddha, Homoeopathy, and Yoga? • What are foods that you don't eat based your religion? *Prompt: Do you fast on some days for religious purposes?* • What are some of the foods or other things that you believe help you with your diabetes? *Prompt: What are they? Tell me how they/it help/s you?*
	What do participants perceive to be facilitators and barriers for self-management behaviors?	• What are some of the difficulties in managing your diabetes? *Prompt: What are some things that you don't do well? What makes it difficult for you to do these well?* • What helps you in taking care of yourself? *Prompt: What are some things that you do well with regard to managing your diabetes? what makes it easy to do?*

Table 3.1 Research Objectives, Research Questions, and Corresponding Interview Questions (cont.).

Research Objectives	Research Questions	Interview Items/Questions
2. To determine if and how acculturation is associated with diabetes control in Asian Indian adults with physician diagnosed type 2 diabetes and who are either in acceptable (HbA1c <7%) or unacceptable glycemic control (HbA1c ≥7%)	Is acculturation related to glycemic control, and if it is how?	• Acculturation Rating Scale for Asians (SL-ASIA) • Glycemic control – HbA1c value • Are there any special difficulties/ benefits in taking care of your diabetes in the U.S. when compared to India? *Prompt: How different do you think it would be if you were to take care of your diabetes in India?* • How do you think your food habits, physical activity, and other daily routines have changed after coming to the U.S.? *Prompt: What are some things you did in India but are not doing here and vice versa?*

3.5.3 Interview Guide

Questions for the in-depth interview guide were developed based on the grounded theory from the "Integration of the Social Ecological Model with the Enhance Behavior Performance Model for Diabetes Self-Management" (Fisher et al., 2005; Sousa et al., 2004) (Fig 3.1), research questions and objectives of this study (Table 3.1). For comprehensiveness and to facilitate triangulation of data, the interview guide was designed such that it consisted of two sections: (i) a quantitative socio-demographic and self-care survey and (ii) a qualitative questionnaire with open ended questions pertaining to diabetes and factors influencing diabetes self-management behaviors.

The quantitative survey included questions related to socio-demographic characteristics such as age, education level, country of education, religion, native language, state of origin in home country, employment status, marital status, household income, household size, type of housing, and use of tobacco and/or alcohol. In addition, information on physician diagnosis of diabetes, diabetes education, co-morbidities, family history of diabetes, medications, diabetes monitoring, and anthropometric values such as self-reported height and weight of the participants were also obtained.

Self-management behaviors were assessed by questions on diet, physical activity, self-monitoring of blood glucose, weight management, medication management, foot care, and regular consultation with a physician. The self-care items in the survey were framed such that they allowed the participants liberal expansion of their responses to qualitative

questions. Participants were asked to rank the order of their ability to perform the seven recommended diabetes self-management behaviors. A value of one indicated 'very easy' and seven indicated 'very difficult.' Participant responses to the survey questions were also audio-taped, which enabled inclusion of important qualitative information in the analysis.

The qualitative questionnaire was designed with open-ended questions and prompt sentences/ questions that facilitated probing for additional information when needed (see table 3.1). The interview questions were designed to obtain comprehensive information to answer the research questions of the study. The interview guide was validated (Phase I) using a two-step approach. First, three nutrition/endocrinology experts of Asian Indian origin revised the interview guide for comprehensiveness, and to check if all questions were worded correctly, and less likely to be misinterpreted by subjects. The experts identified relevancy of content and necessity for additional items to be added to the interview guide.

The experts made several suggestions and added items to improve the readability and usefulness of the data. Second, the interview guide revised by experts was pilot tested using initial interviews with four Asian Indian adults with physician diagnosed diabetes to assure the appropriateness of the language used in the questions. The pilot test included the comprehensive five step procedures of the actual study to determine respondent burden and feasibility of the study. The pilot test facilitated further revision of

the guide and identification of additional probes for some of the questions to be used as needed. The Flesch-Kincaid Readability test to indicate the comprehensive difficulty was performed using Microsoft Office Word 2007 Software. The Flesch-Kincaid grade level of the interview guide was 5.5, which falls between 'easy' and 'very easy' to read based on the principles of readability (DuBay, 2004). Michigan State University Institutional review Board approved the revised version of the interview guide.

3.6 Data Analysis

Data from the survey (socio-demographic and self-care behavior assessment) and the SL-ASIA acculturation instrument were analyzed for descriptive purposes using SPSS (version 17.0, 2009, Chicago, Illinois, SPSS Inc.). Glycemic control, the outcome variable of this study was dichotomized into AC (HbA1c <7%) and UC (HbA1c ≥7%). Participants were also categorized based on their acculturation level as Asian oriented (AO) (SL-ASIA score<2.15) or bicultural oriented (BO) (SL-ASIA score≥2.15) to identify differences in the self-management practices. The cut point of 2.15 was chosen because it was close to the mean value and allowed for an equal distribution of participants in the AC and the UC groups. Due to the fact that there were no participants with an SL-ASIA score above 3.0, there was no category as western oriented for this sample.

To assess weight status, Body Mass Index (BMI) was used. The BMI has been widely accepted as a measure of obesity; and was calculated by dividing weight in kilograms by

height in meters squared. BMI criteria proposed by the WHO Asia Pacific guidelines for Asians was used to categorize subjects as underweight (BMI $\leq$18.5), normal weight (>18.5 – 22.9), overweight (BMI $\geq$23 – 24.9) or obese (BMI$\geq$25) (Inoue et al., 2000).

Dietary analysis of the two 24-hour recalls was done using Nutritionist Pro software (version 3.1.0, Stafford, TX, Axxya Systems, 2009) that has an exclusive Asian Indian database in addition to the United States Department of Agriculture (USDA) and Canadian Nutrient File (CNF). The database contains food coding based on standard sets of nutrient goals for a variety of ages and genders including the Dietary Recommended Intake (DRI) and Recommended Dietary Allowances (RDA). The mean macronutrient intake was compared across groups using independent t tests. Macronutrient intake and meal patterns of participants by glycemic control and acculturation level was compared using chi square distributions. The criteria for categorizing percentage of calories from macronutrients were based on the recommendations of the American Heart Association (AHA) and the U.S. Department of Agriculture (USDA) (Macronutrient composition of total Kcals: 55% carbohydrate, 15% protein, and 30% fat) (AHA, 1986; USDA, 1995; USDA, 1992). These reference values were also used to calculate the amount of carbohydrate, protein, and fat in grams based on a 1600 Kcal diet (mean and standard deviation of total caloric intake of the overall sample was 1516.53 $\pm$ 528.9). According to this calculation, the amount of carbohydrates, protein, and fat based on a diet consisting of 1600 kcal were 220g, 60g, and ~53g, respectively.

Participant self-management ranking was compared between acculturation and glycemic control groups using independent t tests. Bivariate relationships between glycemic control groups and other variables were tested prior to a regression analysis being performed. However, since statistically significant differences were not observed between AC and UC groups, the variables were selected based on the conceptual model of the study. Multiple linear regression analysis using a backward elimination procedure was performed to examine predictors of glycemic control (as a continuous variable) using SPSS (version 17.0, 2009, Chicago, Illinois, SPSS Inc.). The first model included the effect of acculturation level and other independent predictors, which were body mass index, age, gender, duration of stay in the U.S., duration of diabetes, employment status, educational level, prior diabetes education, and annual household income. The interaction effects of acculturation level with other independent predictors were subsequently examined in model 2. Based on R^2 change and model significance level, a decision about whether or not to include the interaction terms was made. Only the main effect variables (BMI, diabetes duration, and annual household income) and the interaction terms that significantly predicted glycemic control were included in the final model.

Qualitative data from the audio-taped interviews were transcribed verbatim and the transcripts were checked for accuracy by listening to the audio conversations several times. The four initial interviews were coded by the primary investigator to identify emergent analytical codes. These codes were categorized into the following broad domains to address the research questions of the study: (i) acculturation of participants,

(ii) participants perceptions about the impact of the disease and diabetes self-management behaviors, (iii) participant's knowledge about diabetes and self-management behaviors, (iv) participant's values and beliefs, (v) influence of health care system, (vi) influence of social support network, (vii) influence of location of residence, and (viii) barriers and facilitators to diabetes self-management behaviors.

A codebook (Appendix I) was developed that included codes with their corresponding tags, definitions, and rules for applications and illustrations. The four initial interviews and the subsequent interviews were coded using the codebook by two researchers using Nvivo 8 (QSR International, 2009) software for qualitative research. The codebook was revised when data emerged in subsequent interviews and coding consistency was established by reviewing coded data, discussing coding discrepancies, and achieving coding consensus by the two researchers to ensure reliability. The data organized by codes were summarized and themes were identified.

As stated by Perone (2003), "Triangulation provides confirmation and completeness. Triangulation is not simply combining different types of data, but it attempts to relate the two types of information so as to leave the validity of each type of information intact. The use of triangulation allows researchers to capture a more complete, holistic, and contextual portrayal and reveal the varied dimensions of a given phenomena, with each source contributing an additional piece to the puzzle. In using triangulation, bias can be minimized and validity enhanced. Neither the qualitative nor the quantitative method

alone could yield the results of the two combined. The sum of the whole is greater than its parts." Therefore, the comprehensive picture obtained from qualitative data was triangulated with the self-management behaviors and acculturation score, which allowed the researchers to check for congruence of information.

CHAPTER 4

RESULTS

The research findings are organized according to the research questions of this study. Triangulation of qualitative and quantitative data is shown for research questions one and two because the participant responses for these two research questions were assessed using both the self-care survey and the qualitative questions.

4.1 Sample Characteristics

Thirty first generation Asian Indian immigrants in Michigan participated in this study. Table 4.1 shows the distribution of the sample by glycemic control status, and acculturation level. There was an equal number of participants in the AC and UC groups when categorized using the HbA1c cut point of 7% as suggested by the ADA (2009). The acculturation level of the overall sample was below the bicultural level of 3.0 ranging from 1.71 – 2.8 with a mean and standard deviation of 2.2 ± 0.2. Participants with an acculturation score <2.15 were categorized as Asian Oriented (AO) those with a score greater than or above 2.15 score were categorized as bicultural Oriented (BO).

Table 4.1 Frequency distribution by glycemic control status and acculturation level of the study sample (n=30).

Acculturation Level	Glycemic Control		Total	P
	AC < 7% n (%)	UC ≥ 7% n (%)		
AO *(< 2.15)*	8 (53.3)	6 (40.0)	14	.36
BO *(≥ 2.15)*	7 (46.7)	9 (60.0)	16	
Total	15	15	30	

Overall acculturation level (mean ± SD) = 2.2 ± 0.2 and (range) = 1.71 – 2.8
AC – Acceptable control; UC – Unacceptable control ; AO – Asian oriented; BO – Bicultural oriented

The characteristics of participants, based on acculturation level and glycemic control are shown in Table 4.2. About half of the participants had lived in the U.S. for over 30 years, had diabetes for less than ten years, and were over 60 years of age. There were sixteen males and fourteen females and an equal number of participants in the AC and UC groups (n=15). Although not statistically significant, there were more males than females in the BO and the UC groups. The data also exhibited a trend that a larger proportion of participants, who had stayed for a longer period of time in the U.S., were more likely to be in the BO and UC groups (Table 4.1). Half of the participants were obese (BMI ≥25), regardless of their glycemic control status based on the Asia-Pacific guidelines for defining obesity. All the participants had medical insurance, and the majority of participants (86.7%) had a strong family history of diabetes. More than half of the participants (60%) had prior diabetes education; regardless of whether they were in the AC or UC groups (Table 4.2).

Table 4.2 Socio-demographic and medical characteristics of the sample (n=30).

		Glycemic Control		Acculturation		Total
		AC (n=15)	UC (n=15)	AO (n=14)	BO (n=16)	(n = 30)
Age (yr)	< 60	9	6	7	8	15
	> 60	6	9	7	8	15
Gender	Male	6	10	6	10	16
	Female	9	5	8	6	14
BMI	Normal wt (>18.5 - <23)	5	3	4	4	8
	Over wt (≥23 - <25)	2	4	2	4	6
	Obese (> 25)	8	8	8	8	16
Annual Household Income	<75,000	2	6	3	5	8
	76,000 - $100,000	4	3	3	4	7
	> 100,000	8	6	7	7	14
Education Level	≤ BS	4	8	5	7	12
	MS	6	6	4	8	12
	PhD/ MD	5	1	5	1	6
Duration of stay in U.S. (yr)	<10	1	3	2	2	4
	10 - 30	8	2	6	4	10
	> 30	6	10	6	10	16
Duration of Diabetes (yr)	< 10	7	8	6	9	15
	10 - 20	4	6	7	3	10
	> 30	4	1	1	4	5
Diabetes education	Yes	9	9	8	10	18
	No	6	6	6	6	12
Family history of diabetes	Yes	15	11	11	15	26
	No	0	4	3	1	4
	Married	14	14	13	15	28
	Employed	10	6	8	8	16
	Medical Insurance (yes)	15	15	14	16	30
	Smoker	1	1	0	2	2

The mean differences in age, body mass index, acculturation level, and glycemic control of participants between the AC and UC groups and AO and BO groups are presented in Table 4.3. There were no significant differences in age and BMI of the participants between the AC and UC as well as the AO and BO groups. The mean HbA1c value and SL-ASIA score were significantly higher in the UC ($P<.01$) and the BO ($P<.01$) groups respectively. However, the mean acculturation level was not significantly different between the AC and UC groups.

Table 4.3 Mean differences in age, body mass index, HbA1c value, and SL-ASIA score within groups (mean ±SD, range) (n=30).

	AC $\bar{X} \pm$ SD (Range)	UC $\bar{X} \pm$ SD (Range)	T	p	AO $\bar{X} \pm$ SD (Range)	BO $\bar{X} \pm$ SD (Range)	t	p
Age (yr)	54.4 ± 13.1 (28.7 – 74.8)	59.9 ± 9.4 (41.2 – 69.1)	-1.3	.20	54.6 ± 13.7 (28.7 – 74.8)	59.4 ± 9.1 (41.2 – 70.4)	-1.1	.27
Body Mass Index	24.9 ± 2.4 (20.6 – 29.3)	25.6 ± 2.5 (21.5 – 29.8)	-.75	.46	25.3 ± 2.7 (20.6 – 29.8)	25.2 ± 2.2 (21.5 – 28.2)	.11	.91
Glycemic Control (%)	6.4 ± 0.3 (5.8 – 6.9)	7.9 ± 0.7 (7 – 9.3)	-7.3	<.01	7.2 ± 1.03 (6.3 – 9.3)	7.1 ± 1.0 (5.8 – 9.0)	.38	.71
Acculturation Level	2.1 ± 0.2 (1.8 – 2.4)	2.2 ± 0.3 (1.7 – 2.8)	-1.1	.28	2.0 ± 0.1 (1.7 – 2.1)	2.4 ± 0.2 (2.2 – 2.8)	-7.1	<.01

AC = Acceptable glycemic control (HbA1c <7%) and UC = Unacceptable glycemic control (HbA1c ≥7%)
AO = Asian Indian oriented (SL-ASIA score <2.15) and BO = Bicultural oriented (SL-ASIA score ≥2.15)

4.2 Dietary Quality and Meal Patterns of Participants

The independent t test comparison of mean energy and nutrient intake of participants' (from the two 24-hr dietary recalls) within glycemic control and acculturation groups is shown in Table 4.4. The mean energy, macronutrient, and fiber intake of participants was not significantly different between the AC and UC or AO and BO groups. However, the fiber intake in all groups were <25g/ day. Table 4.5 shows the percentage of macronutrients, meal frequencies during weekday and weekend, and use of supplements within groups. The percentage of calories from protein was significantly higher in the BO than the AO group (p=.03). Participants in the AC (p=.03) and BO (p=.01) groups were more likely to take dietary supplements such as multivitamins, calcium, Omega 3 Fatty Acids, Whey protein, and Vitamin E [AC(13) vs. UC(6) and AO(5) vs. BO(13)]. The proportion of alcohol consumers were significantly higher in the BO group (p=.01) [AO(2) vs. BO(11)]. Interestingly, the types of foods consumed by participants did not vary between the acculturation and the glycemic control groups. All the participants included both western (e.g. waffles, cheese, Barbeque chicken, meat/vegetarian patties) and Asian Indian foods (e.g. meat or vegetable pulao, sambar (lentil curry/ soup), kheer (Asian Indian dessert equivalent to pudding), and curries) in their diet. The majority of the participants consumed a western breakfast as opposed to traditional Asian Indian foods, typically consumed for breakfast in India.

Table 4.4 T-test comparisons of selected macro-nutrients based on two 24-hour diet recalls, by glycemic control and acculturation level. (n=30).

Calories & Nutrients	Glycemic Control		P	Acculturation Level		P
	AC (n = 15)	UC (n = 15)		AO (n = 14)	BO (n = 16)	
Calories (Kcal)	1558 ± 559	1475 ± 512	.68	1515 ± 497	1517 ± 571	.99
CHO (g)	232.9 ± 87.2	217.6 ± 71.6	.60	230.8 ± 76.2	220.4 ± 83.2	.73
Protein (g)	62.0 ± 25.4	55.5 ± 19.1	.43	53.4 ± 17.3	63.4 ± 25.6	.23
Fat (g)	46.1 ± 18.7	43.3 ± 18.4	.69	42.9 ± 18.2	46.3 ± 18.8	.63
Sat fat (g)	11.1 ± 5.0	11.9 ± 5.8	.66	11.7 ± 5.9	11.4 ± 4.9	.87
Fiber (g)	19.1 ± 7.5	18.2 ± 7.6	.77	17.5 ± 7.6	19.8 ± 7.3	.40

Table 4.5 Selected nutrient composition and meal patterns based on two 24-hour diet recalls, by glycemic control and acculturation level. (n=30).

	AC (n=15) n (%)	UC (n=15) n (%)	P	AO (n=14) n (%)	BO (n=16) n (%)	P
Energy (Kcals)						
≤1600	6 (40.0)	9 (60.0)	.23	6 (42.9)	9 (56.3)	.36
>1600	9 (60.0)	6 (40.0)		8 (57.1)	7 (43.8)	
Carbohydrates (g)						
≤220	6 (40.0)	7 (46.7)	.50	4 (28.6)	9 (56.3)	.12
>220	9 (60.0)	8 (53.3)		10 (71.4)	7 (43.8)	
% of Calories from Carbohydrates						
≤55	4 (26.7)	4 (26.7)	.66	3 (21.4)	5 (31.3)	.43
>55	11 (73.3)	11 (73.3)		11 (78.6)	11 (68.8)	
Protein (g)						
≤60	8 (53.3)	9 (60.0)	.50	9 (64.3)	8 (50.0)	.34
>60	7 (46.7)	6 (40.0)		5 (35.7)	8 (50.0)	
% of Calories from Protein						
≤15	8 (53.3)	7 (46.7)	.50	10 (71.4)	5 (31.3)	.03
>15	7 (46.7)	8 (53.3)		4 (28.6)	11 (68.8)	
Fat (g)						
≤53	9 (60.0)	11 (73.3)	.35	10 (71.4)	10 (62.5)	.45
>53	6 (40.0)	4 (26.7)		4 (28.6)	6 (37.5)	
% of Calories from Fat						
≤30	10 (66.7)	11 (73.3)	.50	10 (71.4)	11 (68.8)	.60
>30	5 (33.3)	4 (26.7)		4 (28.6)	5 (31.3)	
Fiber (g)						
<25	12 (80.0)	13 (86.7)	.50	13 (92.9)	12 (75.0)	.21
≥25	3 (20.0)	2 (13.3)		1 (7.1)	4 (25.0)	
Number of meals (weekday)						
≤4 meals	7 (46.7)	6 (40.0)	.50	6 (42.9)	7 (43.8)	.63
>4 meals	8 (53.3)	9 (60.0)		8 (57.1)	9 (56.7)	
Number of meals (weekend)						
≤4 meals	8 (53.3)	12 (80.0)	.12	8 (57.1)	12 (75.0)	.26
>4 meals	7 (46.7)	3 (20.0)		6 (42.9)	4 (25.0)	
Alcohol consumers (yes)	7 (46.7)	7 (46.7)	.64	2 (21.4)	11 (68.8)	.01
Supplements (yes)	12 (80.0)	6 (40.0)	.03	5 (35.7)	13 (81.3)	.01

Research Question (i): Is acculturation related to glycemic control, and if so, how?

4.3 Relation of Acculturation to Glycemic Control

4.3.1 Findings from the Socio-demographic and Self-care Survey (Quantitative Findings)

Table 4.7 displays the final multiple regression model with the variables that significantly predicted glycemic control (acculturation, body mass index, diabetes duration, and annual household income). BMI and diabetes duration were continuous variables while annual household income was dichotomized as a categorical variable with income<100,000 as the reference category. Mean correction was performed for predictors that were continuous variables (acculturation, BMI, and diabetes duration) such that they were assigned a mean value of zero. This is done in order to reduce the collinearity between these variables and the interaction terms based on their products, thereby reducing the standard error of the regression coefficients. Since age, gender, duration of stay in the U.S., employment status, educational level, and prior diabetes education were not significant, they were excluded from the model.

There was no significant association between acculturation level and glycemic control when linear regression analysis was performed with only acculturation, BMI, diabetes duration, and annual household income as predictors of glycemic control (R^2 = .019; p =.98) (see Table 4.7). However, when the interaction of acculturation and these predictors were added, the main effect of acculturation (unstandardized b= -2.67; p= .03) and the interaction of acculturation with annual household income (unstandardized b= 7.19; p=

.01), diabetes duration (unstandardized b= .30; p= .02), and BMI (unstandardized b= 1.11; p= .01) significantly predicted higher HbA1c values (R^2 change = .368; F change = 4.208; p =.02). Annual household income, BMI, and diabetes duration did not significantly predict glycemic control in the absence of an interaction with acculturation (p>.05). Interactions of annual household income, diabetes duration, and BMI with acculturation status were both statistically significant and positive, which indicates that the relationship between acculturation and glycemic control is determined by the specific values of these three predictors (annual household income, BMI, and diabetes duration).

Table 4.6 Predictors of glycemic control among Asian Indians with physician diagnosed diabetes (n=30).

	Model 1 R^2 = .02 (p=.98)			**Model 2** R^2 change = .37; F change = 4.20 (p=.02)		
	Unstd. B	**SE**	**p**	**Unstd. B**	**SE**	**p**
Intercept	7.321	.28	<.01	7.08	.25	<.01
[a]Acculturation	.049	.82	.95	-2.67	1.14	.03
Income (>$100,000)	-.259	.41	.53	.03	.35	.94
[a]Diabetes duration	-.006	.02	.76	-.01	.02	.75
[a]BMI	-.023	.08	.78	-.08	.08	.30
Acculturation*Income				7.19	2.31	.01
Acculturation*BMI				1.11	0.40	.01
Acculturation*Diabetes duration				0.30	0.12	.02

Outcome variable – Glycemic control assessed using HbA1c laboratory value

[a]Mean corrected variables

Model 2 – Includes interaction terms of acculturation with covariates

4.3.2 Perceptions about Lifestyle and Diabetes Management in the U.S. (Qualitative Findings)

The two themes that emerged relative to acculturation and achievement of glycemic control by the participants were 'changes in lifestyle after immigration' and 'ease of management of diabetes in the U.S.' These were perceived within the context of "new country" influences.

Changes in lifestyle after immigration

The changes that participants reported after immigration were: health perceptions, changes in physical activity, lack of extended family support, and dietary changes such as increased meat and alcohol consumption. Regardless of acculturation status, six participants in the AC group mentioned that health awareness increased after immigration to the U.S., which was not mentioned by participants in the UC group. *"I find that I've benefited more because there is more awareness here (U.S.) of the disease and you do find more information in the books, also the classes as an adult you can take um....even if you have to pay for it by yourself or your insurance covers it, there are a lot more information available which could guide you manage your diabetes better." – (female, AC, AO).*

Similarly, four participants in the AC group, who were also AO mentioned that physical activity increased after immigration. *"...it's easy to gain weight because of the food that's available and the weather of course in Michigan, we've always been in Michigan*

so, but then I started reading about stuff and exercising, so exercise I would say is the most that has changed" – (female, AC, BO).

Likewise, a few participants in the AC group, who were BO, also specified healthy modifications to Asian Indian recipes. "*Basically I think the diet has changed, which I said the uh think the Indian diet is the worst diet. That regular conventional diet is the worst diet that people eat. I don't know. There is lot of fat and oil and they eat too much, so heavy and I think it's just like putting diesel in your car, I don't know. I think Indian cooking, conventional Indian diet is...is extremely injurious to your health, but my style of Indian diet is the best diet in the world. If you just eat good curried vegetable with very small amount of oil...stir fry you might call and with some good spices and all that. The Indian spices are just are the most healthiest things" – (male, AO, BO).*

On the other hand, participants in the UC group, who were BO, mentioned decreased physical activity (n = 2) and increased meat consumption (n = 3) after coming to the U.S. *"In India I was totally vegetarian, I come from a vegetarian family, so after coming here (U.S.) I became a non-vegetarian so that's a big change. I don't know whether that has anything to do with diabetes or not, but that was a big change" – (male, UC, BO).*

Ease of management of diabetes in the U.S.

For the second theme 'ease of management of diabetes in the U.S.', participants in both the AC and UC groups consistently mentioned that diabetes was easier to manage in the

U.S. than in India (participants recollected their experiences from the days before immigration to the U.S. or when they vacationed in India). The reasons given for easier management in the U.S. as specified by the participants were: availability of exercise facilities, absence of negative influences by social networks, good health care facilities, quality of healthy food choices, availability of self-monitoring devices, medical insurance, potentially better quality medications, greater health awareness, and infrastructure. *"No I think it is easier here (U.S.) than in India, we have insurance. In India there is not much of insurance system, the medicines are very expensive and I am not sure if they are correct. If you can't manage in this country, then you can't manage anywhere in the world, yeah" - (male, AC, AO).*

However, two participants in the UC group, who were AO, mentioned that it would have been easier to manage diabetes if they were in India. The reasons mentioned were favorable weather, opportunity to use complementary and alternative medicine, and a greater demand for physical activity due to the types of occupation and greater use of public transportation. *"If I am in India, generally my diabetes does good because little bit automatically you walk so that helps. And somehow the weather, it is possible because of the weather that also helps."- (male, UC, AO)*

4.3.3 Triangulation of Data on Acculturation and Glycemic Control

A trend was observed in the survey data depicting a larger proportion of participants in the UC (10 vs. 6) and BO (10 vs. 6) groups with a longer duration of stay in the U.S.

Multiple linear regression analysis showed the relationship between acculturation and HbA1c levels to be dependent on annual household income, diabetes duration, and BMI.

Data from the qualitative interview suggested that health promoting behaviors were more likely to be evident among AC participants after immigration. Participants in the AC and AO groups reported increased health awareness and increased physical activity after immigration. On the other hand, UC and BO participants specified sedentary lifestyle and increased meat and alcohol consumption. Nutrient analysis of the 24-hr dietary recalls demonstrated a significantly higher percentage of calories from protein in the BO than the AO group ($P<.05$). Similarly, data from the quantitative survey, although not significant showed an increasing trend in the number of alcohol consumers in the BO than the AO (11 vs. 3) group. A larger proportion of participants in the UC (n=12) and BO groups (n=12) reported consuming less than or equal to 4 meals (inclusive of snacks) during weekends versus the AC (n=8) and AO groups (n=8).

The majority of the participants regardless of acculturation or glycemic control levels believed that exercise and health care facilities, healthy food choices, availability of self-monitoring devices, and medical insurance were favorable for diabetes management in the U.S. Two AO participants in the UC group believed that diabetes management was facilitated by the Indian weather, opportunity to use complementary medicines, and the necessity for employment and transportation physical activities. The qualitative findings demonstrate a trend in the changing dietary (increasing westernization of the diet) and

physical activity behaviors (increasing sedentary lifestyle) of the participants who were in the BO and UC groups. While in the quantitative data, interactions of acculturation with BMI, diabetes duration, and annual household income were significantly associated with higher HbA1c levels. Although a limited sample size may have influenced the findings from the quantitative data, it is important to recognize the influence of individual characteristics such as BMI, annual household income, and diabetes duration on the relationship between acculturation and HbA1c levels based on the significant interactions of these variables with acculturation in the multiple regression model.

The majority of the participants, regardless of the acculturation or glycemic control status, specified several advantages of diabetes management in the U.S. These included exercise facilities (easy availability, accessibility, and affordability), absence of a social network, which may have a negative influence in diabetes management, excellent health care system and facilities, availability of healthy food choices and self-monitoring devices, medical insurance benefits, quality of medications, and improved health awareness after immigration. Due to adaptation to the host country's systems, these environmental factors perceived as beneficial to diabetes management by Asian Indians, could have potentially played a role in the positive association between HbA1c levels and the interactions between acculturation and income, BMI, and diabetes duration.

Research Question (ii): How do participants perceive the impact of the disease and the required self-management behaviors?

4.4 Diabetes Self-management Behaviors

4.4.1 Adherence to Self-management Behaviors (Quantitative Findings)

The quantitative survey responses pertinent to participant self-management behaviors are summarized in Tables 4.8, 4.9, and 4.10. Data demonstrated that there were more participants in the AC group who adhered to rigid diabetes self-management behaviors such as performing frequent exercises for a longer duration, following a special diet for diabetes, consulting their physician on a regular basis, and checking their feet on a regular basis.

The mean ranking of participants' ability to perform self-management behaviors shown in Table 4.11 indicated the self-perceived relative difficulty in performing the ADA recommended self-care practices. A lower mean value for any self-management behavior within a group indicated that more participants in that group had reported that particular self-management behavior to be easier. Mean values for the perceived difficulty with adherence to all the self-management behaviors were similar between the two groups; however, the mean values for physician consultation and medication adherence for UC participants were slightly higher than those for the AC group (significant at $p<.10$). Participants in both AC and UC groups perceived taking medications to be the easiest among all self-management behaviors, while consultation with a physician in the AC group and regular exercise in the UC group were perceived as the most difficult.

Table 4.7 Participant responses with regard to adherence to dietary and exercise behaviors from the self-care survey (n=30).

	AC (n = 15) n (%)	UC (n = 15) n (%)	p
Healthy Eating			
Do you follow any special diet? (yes)	11 (73.3)	7 (46.7)	.13
What do you do?	**More:** veg (2), protein (1), complex carbohydrates (3) **Limit:** carbohydrates (5) **Avoid:** added sugar & sweets (8), specific fruits or veg (4), red meat (1) whole milk products (1) **Reduce:** fat/ fried foods (4) **Others:** Early dinner (1), eat in moderation (2)	**More:** veg (3), protein (1), complex carbohydrates (1) eggs (1), nuts (1), dairy products (2) **Limit:** carbohydrates (5) **Avoid:** sweets (2) fruit juices (1) **Reduce:** fat (1) **Others:** Use sugar free products (3), very low calorie diet (1) No changes at all (4)	
How often do you follow this diet	All the time (12) except when socializing (4) Most of the time (4) difficult during weekends (2)	All the time (5) – except when socializing (2) Most of the time (5) – except when away from home (1) No special diet (5)	
Regular Exercise			
Do you exercise? (yes)	13 (86.7)	10 (66.7)	.20
What do you do?	Yoga (3), Walking (12), Treadmill (2), Gym (5), Swimming (1), Snow shoveling (1), Running (1), physical activity in daily chores (4), no physical activity (3)	Yoga (1), Walking (5), Treadmill (3), Gym (2), Swimming (3), Snow shoveling (2), yard work (2), cycling (2), golf (1), physical activity in daily chores (2), no physical activity (4), Do not exercise (5)	
Exercise duration/ week			
< 150 min	3 (20.0)	9 (60.0)	.03
≥ 150 min	12 (80.0)	6 (40.0)	
Exercise frequency			
None or < 5 times/week	4 (26.7)	9 (60.0)	.07
Everyday or ≥ 5 times/week	11 (73.3)	6 (40.0)	

Table 4.8 Participant responses with regard to adherence to medication and weight control behaviors from the self-care survey (n=30).

	AC (n=15) n	UC (n=15) n
Medication Prescriptions/Adherence		
Medication prescription		
Tablets	8	11
Insulin w/ wo tablets	5	3
None	2	1
Medications for health conditions		
Diabetes	13	14
High BP	8	5
Cholesterol	5	8
Heart	4	4
Acidity	1	4
Thyroid	2	2
Others	2	4
Number of medications		
≤ 3	10	6
≥ 4	5	9
Do you have problems taking medications?		
yes	3	2
No	10	12
Weight Control		
Are you trying to lose or gain weight?		
Lose	11	9
Maintain	3	5
Gain	1	1
Current weight relative to weight at diagnosis?		
Lost	10	9
Maintained	0	3
Gained	5	3
Current weight relative to highest adult weight?		
Lost	12	12
Same	3	3

Table 4.9 Participant responses with regard to adherence to self-monitoring of blood glucose, foot care, and physician consultation behaviors from the self-care survey (n=30).

	AC (n=15) n	UC (n=15) n
Self-monitoring blood glucose		
Did your doctor ask you to check your blood sugar at home?		
Yes	11	13
No	2	2
Don't have a doctor	2	0
How many times did your doctor ask you to check your blood sugar at home?		
Doctor did not ask to check	2	2
Once/ day	5	6
2-3 times/ day	3	5
2 – 3 times/ week	2	2
Don't have a doctor	2	0
Don't know	1	0
How many times are you able to check your blood sugar at home?		
Doctor did not ask to check	1	1
Once/ day	2	1
2-3 times/ day	2	2
Once/ week	2	2
2-3 times/ week	5	5
Once/ month	2	0
Don't check	1	4
Foot Care		
Did your doctor ask you to check your feet at home?		
Yes	8	7
No	5	6
Doctor checks	2	2
How often are you able to check your feet at home?		
Every day	10	2
Don't check	2	4
Few times/ month	1	4
Doctor did not ask to check	1	3
Don't have a problem	1	2
Physician Consultation		
How many times have you seen a doctor in the past year for your diabetes?		
Don't see	2*	1
<3	3	6
≥3	10	8

*Two participants in the AC group reported that they did not have a doctor

Table 4.10 T-test comparison of participants' perceived difficulty to perform self-management behaviors (n=30).

	Survey Responses		Ability to perform self-management (ranking)*		
	AC (n=15)	UC (n=15)	AC $\bar{x} \pm SD$	UC $\bar{x} \pm SD$	P
Follow special diet	11	6	3.3 ± 1.8	4.2 ± 1.7	.15
Regular exercise	13	9	4.4 ± 1.9	5.0 ± 1.7	.37
[a]Physician consultation	10	8	4.9 ± 1.8	3.7 ± 2.1	.08
Medication adherence	10	12	2.7 ± 2.0	1.7 ± 1.0	.10
Foot care	10	6	3.5 ± 2.4	4.3 ± 1.2	.23
Weight control	14	14	4.7 ± 1.6	4.7 ± 1.8	1.00
[b]Self-monitoring blood glucose	4	6	4.3 ± 2.0	4.1 ± 2.5	.81

*Self-management ranking: 1 = easy....7 = difficult
[a] check with a physician $\geq$ 3 times/ year
[b] everyday

4.4.2 Perceptions about the Impact of the Disease and Self-management (Qualitative Findings)

Two themes "lifestyle changes after diagnosis" and "ease of management of diabetes on a daily basis" emerged in the qualitative analysis.

Lifestyle changes after diagnosis

The majority of participants in the AC group reported more positive lifestyle changes (n=9) after diabetes diagnosis, while most in the UC group reported no major lifestyle changes (n=9). The positive changes mentioned were exercising more; taking medications as prescribed; regular self-monitoring of blood glucose; positive attitude towards health and life; weight control; and making healthier food choices, specifically greater awareness about food and health, including more salads and complex

carbohydrates in the diet, avoiding added sugar, controlling portion sizes, and giving up some favorite foods. *"I've been testing everyday so that is one thing and secondly my eating has definitely changed, try to be more careful with my eating so that has definitely affected and exercise. Exercise I have always done so that's not something, trying to make sure I do it, I usually have inertia sometimes, I try to avoid this inertia" - (male, AC, BO)*

Although the majority of participants in the UC group reported no lifestyle changes after diagnosis, four mentioned a few dietary changes such as using diet soft drinks instead of regular, reducing sweet food intake, avoiding excess alcohol and fried foods, and trying to control portion sizes when eating at home. *"I would eat a lot earlier, so that has changed. Sometimes I get frustrated with time...I try to control myself...I need to get more, again typically if there is like chicken or something cooked or if we go out to eat, I tend to not follow the portions or whatever that I am supposed to" - (male, UC, AO)*

A few participants in the AC group (n=5) mentioned negative physiological and psychological changes such as hypoglycemia, immobility due to amputation, easy weight gain, tiredness, and losing self-confidence after diagnosis with diabetes. On the other hand, responses in the UC group for negative changes were depression, difficulty in cooking special meals for diabetes, inability to consume alcohol and favorite foods, and tiredness. "*I am going through depression and not happy because I never ate so much, but I could at least choose some food, which one I can't do it now. I love meat and*

whenever I socialize I love to drink, don't want to get drunk, but love to drink you know, socially always" – (female, UC, BO).

Ease of management of diabetes on a daily basis

The majority of participants in the AC group perceived performance of self-management behaviors to be easy because they learned how to manage diabetes over the course of time and through practical experiences. Only three participants in the UC group perceived self-management to be easy. When asked about daily management of diabetes, eating healthy and exercising regularly were the most mentioned as being important for diabetes management by participants in both groups; however, more challenges in performing the self-management behaviors on a regular basis were expressed by the UC group.

Participants in the AC group had a tendency to explain dietary changes in detail versus the UC group who simply mentioned "eating healthy." The dietary changes mentioned by the AC group were: carbohydrate control, reducing sweets and added sugar, portion control, more rigid diet after "treats" were consumed, and reliance on the spouse for selecting foods to facilitate portion control when socializing. On the other hand, two participants in the UC group perceived difficulty in avoiding food temptations even though they tried to regulate their diet. *"I am just trying to change my diet habits so that is the one I am doing daily...avoiding the temptation is the challenge because when there are everything available right in front of the eyes and it's hard to resist" - (male, UC, BO).*

Two participants in both groups expressed inconsistency in exercise routine due to a busy schedule. Participants in the AC group were more likely to play sports, walk instead of drive, perform yard work and house chores, and incorporate exercise into their daily activities. Although a few participants in the UC group mentioned these activities, many (n=4) expressed a lack of motivation as the main challenge to exercise. *"I take all my medicines very well, regularly. I know that's in my hands so I take my medication very regularly, diet is alright, but don't tell me to exercise" - (female, UC, BO).*

Taking medications was perceived to be a part of daily routine as it did not require major lifestyle changes in the UC more than the AC group. *"I have my medicines in the morning, I have my medicines in the night, I make sure I have my medicines that he (physician) gives me. It's something that is there in the back of my mind, its not that it is hampering the way I am living or my lifestyle"- (male, UC, BO).* Self-monitoring blood glucose was mentioned as a part of daily routine by one and two participants in the AC and UC groups, respectively as were foot care and consultation with physician by one participant in each group.

4.4.3 Triangulation of Data on Diabetes Self-management

The key findings of triangulation of information from the quantitative and qualitative data for self-management behaviors were as follows: participants in the AC group consistently mentioned eating healthy in the survey and the in-depth interview. Data from the qualitative interviews provided a detailed explanation of dietary and physical changes by

the AC group, similar to survey details. "*I look at the food and I think, should I or should I not eat. I pick and choose. So, like yesterday at the party, there were some other desserts, which I chose not to eat because I chose from three or four varieties, I gave myself the choice which ones do I really want to taste and eat. So I pick and choose, I try to add more complex carbs so I add more salads to food than having more refined carbs. It's a huge change. I don't add sugar to my tea, I can live with little things but at the same time then I am thinking "okay I can avoid this much sugar in the tea at the same time may be in a few days down the road, I can yearn myself to eat a cookie"- (female, AC, AO)*

A trend that was evident from the data obtained from quantitative and qualitative methods was that participants in the AC group excluded items such as added sugar, refined carbohydrates, and foods rich in fats contrary to changes made by participants in the UC group which were in the form of inclusion of foods such as nuts, eggs, sugar free products, and dairy products. "*Nuts do help, I just take a little bit you know like 5 cashews or 4, just that much... you can all the foods over here without sugar, you can get sugar-free chocolates, you can get sugar-free this and that so at least that has helped" – (female, UC, BO)*

The perceived difficulty in adherence to healthy eating during the weekends and when socializing in both the AC and UC groups, which was evident in the survey results also emerged in the qualitative findings. "*...during the weekdays I know I can manage my diet very well because I am at work to have the time of the day so I try to control the carbs*

intake during the weekdays. Weekends I know I am exposed to such yummy foods, sometimes...its hard to resist and avoid" – (female, AC, AO). Some examples of foods which appeared on the weekend day 24 hour recalls included pizza, kheer (sweet pudding), halwa (Asian Indian dessert), and deep fried foods/ snacks such as samosas, puris, fried fish, papad, and spicy Asian Indian snack mixtures, all of which have a large amount of added sugar and/ or fat.

Likewise, UC participants described tiredness, lack of motivation, and physical discomforts as challenges to a regular exercise regimen, which explains their expressed difficulties in exercise adherence as evidenced by the lower frequency and duration of exercise compared to AC observed in the survey data. *"...well I could do the biking too but I get very much leg cramps. Legs get tired very easily but the walking thing you know, the treadmill if I have I think that burns lot of calories... I was doing the elliptical and here the aches...I went to the doctor and the doctor says the bone is getting thinner" – (female, UC, BO)*

A few participants in the AC group expressed in the in-depth interview that they were not impressed with their health care, which was consistent with the self-management ranking. AC participants ranked consultation with a physician as the most difficult. However, survey analysis showed that they were more likely than the UC group to consult a physician three or more times a year despite the perceived difficulty. Consistency between quantitative and qualitative findings was distinctly observed in medication adherence of UC participants. Participants in the UC group perceived taking medications

as easier than major lifestyle changes in the qualitative interview. In the quantitative data, medication adherence was reported to be relatively easier in the UC versus the AC group as evidenced by the lower mean value for medication adherence in the survey item for participant ranking of perceived difficulty to perform diabetes self-management behaviors ($p<.10$) (Table 4.9).

4.5 Factors Influencing Diabetes Self-management

The quantitative data for individual (acculturation, age, educational level, income status, duration of stay in the U.S., duration of diabetes, prior diabetes education, and family history of diabetes) and environmental (medical insurance) factors were shown in the descriptive characteristics in Table 4.2. Since the role of acculturation was discussed earlier, the other findings pertaining to the influence of individual and environmental factors on diabetes management from the qualitative interview are presented below:

4.5.1 Individual Factors

Research Question (iii): How does the subjects' knowledge of diabetes affect their self-management behaviors?

4.5.1.1 Diabetes Knowledge

The themes that emerged for diabetes knowledge of participants from the qualitative interviews were "understanding the disease and consequences", "knowledge about the outcomes of self-management", and "awareness of the important self-management behaviors".

Understanding the disease and consequences

Participants' responses for the theme "Understanding the disease and consequences" were mainly derived from the questions "Can you tell me what diabetes is?" and "what do you think will happen if you do not take care of your diabetes?" All participants in the AC group and the majority of participants in the UC group had in-depth knowledge about the disease onset and progress.

Participants were for the most part astute in specifying that diabetes is the culmination of a defective insulin response to high blood glucose concentrations in the body because the body is either not producing or not able to use the available insulin. Four participants in the UC group had a vague knowledge about the mechanism of diabetes. *"I know there are two types, high sugar and one is low sugar. I've got high sugar, that's all" - (male, UC, BO)*

However, all the participants in both the AC and UC groups were well aware of the associated short and long-term consequences of inadequate management of diabetes. Participants in both the AC and UC groups mentioned that insufficient care may lead to serious complications such as heart and circulation defects, stroke, hypertension, eye disorders, kidney problems, peripheral nerve problems/ amputations, coma, liver problems, dental problems, weight gain, and perhaps even death. The other consequences specified were: unhealthy life, weakness and fatigue, increased medical costs, the necessity for insulin therapy, and worsening of the disease.

Knowledge about the benefits and types of self-management behaviors

The concepts that were discussed were the potential benefits of adequate self-management. Participants predominantly mentioned that self-management would lead to a normal and healthy life followed by prevention and delay of complications. *"Just that these uh, these other complications will not happen soon. It will happen perhaps they will happen eventually, but at a later stage" - (male, UC, AO).*

All the participants in the AC and UC groups had some knowledge about some of the key diabetes self-management behaviors for controlling the disease. When asked to identify specific key self-management behaviors, a healthy diet [AC (14) vs. UC (10)] and regular exercise [AC (11) vs. UC (9)] were the two behaviors that were most frequently mentioned followed by taking medications [AC (6) vs. UC (5)] and self-monitoring blood glucose [AC (5) vs. UC (4)]. *"Maintaining low blood glucose levels, healthy weight, keeping your sugar levels low mainly by eating healthy, exercising regularly..."- (female, AC, AO).*

Reducing stress level was also interestingly mentioned by one participant in both the AC and UC group. In addition, weight management [AC (3)] was specified by participants in the AC group and checking hemoglobin A1c [UC (2)] and regular follow-up visits with a physician [UC (3)] by the UC group. *"It is very essential that you don't miss your medication because it is a supplement to your insulin deficiency ... you should definitely take the three month check up if the doctor says because I give him the authority on those sort of things because he is much more knowledgeable than me"- (male, UC, BO).*

Importance of Diet, Medications, and Physical Activity in Self-management

Participants were asked about the roles played by food, medicine, and exercise in diabetes self-management. When the participants were asked if any of the three was more important than the others, the majority of the participants in both groups mentioned that the combined effect of the three or any two worked together to maintain diabetes control. However, five participants in the AC versus two in the UC group referred to exercise alone as the most important. *"Exercise is probably the most important, but I really should be doing more exercise. I don't do that much, it's kind of difficult for me, but I have to do it so I do it. But I think exercise is most important"- (male, AC, AO).*

Participants were also asked about the independent roles of food, medicine, and exercise and how each functions in diabetes management.

Diet: Participants in both the AC and UC groups recognized the role played by food in controlling blood sugar [AC (10) vs. UC (5)] and the need to monitor food intake [(AC (8) vs. UC (5)]. In addition, participants in the AC group mentioned that food could improve satiety [AC (2)] as well as the importance of small frequent meals [AC (2)], and portion control [AC (2)]. *"You have to restrict the calories and yet eat a larger volume, which you can only do by reducing your fat intake because fat has more calories grams for grams. So the aim is to reduce your calories and eat a larger volume to satisfy your stomach" – (-male, AC, BO).*

Three participants in the UC group, who recognized the importance of food in blood glucose management, also mentioned some of the challenges they faced such as not being able to eat the desired amount after diagnosis with diabetes, and the need for more medications when sweet foods were consumed. One participant in the AC and two participants in the UC group said that they did not know the role of food. One participant in each group mentioned that food is important for diabetes management regardless of whether the patient takes medications or not. *"Even though you can take medicines, if you don't manage your food intake, you are not going to be able to have regular sugar levels in your body. So, it does play a key role" – (female, AC, AO)*

Exercise: The majority of participants in both the AC (n=15) and UC (n=13) groups mentioned that exercise plays a critical role in diabetes management. Exercise was perceived by several participants to be important even in the absence of diabetes [AC (4) vs. UC (1)], for metabolism of carbohydrates [AC (3) vs. UC (3)], and as an adjunct to medications [AC (1) vs. UC (1)]. *"Its very important because exercise not only burns the sugar, it gives you lot of other advantages you know, circulation, improves circulation, improves your strength, muscle strength, you can be more mobile" – (male, AC, AO).*

One participant in each group reported that they did not know the role of exercise in controlling diabetes. Three participants in the UC group acknowledged that exercise was beneficial, but difficult to accomplish. *"They tell me it is very good and I would love to do a little more exercise but I can't, I just can't do exercise, I don't know why...I have lots of time the whole day, I don't know why" – (female, UC, BO).* The other roles for

exercise mentioned by participants in the AC group were for weight control [AC (2)] and a healthy life [AC (3)]. Participants in the UC group specified that exercise helps to burn calories [UC (6)], produce insulin [UC (1)], and for fitness [UC (1)].

***Medications*:** When asked about the role of medicine, the majority of participants in the AC and UC groups mentioned the importance for blood sugar control. Four participants in the UC group said that medications were not effective, and did not play a major role. Four in the AC and two participants in the UC groups said that medicine would help in the management of diabetes if diet and exercise did not work. *"I think the medicines are doing a great job in controlling my diabetes regardless of not exercising or not following strict sugar" – (male, UC, AO)*

Two participants in the UC and one in the AC group said that medicines might not work if dietary and exercise habits were not good. One participant in each group believed that medicines would decrease the likelihood of complications. Two participants in the AC group perceived that tablets did not work as efficiently as insulin and two other participants in this group perceived that diabetes should not be managed just by oral medications, but with insulin injections as well. *"Pills are useless in my experience, more people are dying because they depend on pills and they are afraid of taking insulin and they may have some value in early cases but at the end of the day most people will, if they didn't have pills, more people will live healthier and will have less complications of diabetes" – (male, AC, BO)*

Research Question (iv): How does an individual's values and beliefs influence self-management behaviors?

4.5.1.2 Values and Beliefs

The themes that emerged for participants' values and beliefs were "beliefs about complementary and alternative medicine", "religious beliefs", and "perceived diabetes enhancement foods."

Beliefs about complementary and alternative medicine

There were no differences in the perceptions of participants in the AC and UC groups about alternative medicines, with the exception that four participants in the AC group were either physicians or had come from a family of physicians, and therefore reported that they firmly did not believe in alternate therapies. *"(Alternative medicines) all kinds of myths, eat this and eat jamuns and all silly stories. They kill themselves, you know. Its insulin, its insulin, you think all these things can get, people are so stupid" – (male, AC, BO)*

Three and six participants in the AC and UC group respectively, reported that they either did not believe in or had never tried any type of complementary or alternative medications. Six participants in each group mentioned that they had the experience of taking alternative medications for either diabetes or other health conditions. A few participants were skeptical about the side effects of alternate medications. However, some [AC(1) vs. UC(3)] perceived it to be a natural way of treatment compared to

pharamacotherapy. A few participants [(AC(1) vs. UC(4)] expressed that they had experienced satisfactory results from prior use of alternative medications. Some participants in both the AC and UC groups expressed concerns that they had purchased alternate medications in India, but experienced limited accessibility to alternative medicine in the U.S. *"I sometimes bring some food, medicines from overseas for a short while and consume ...It helps actually, yeah it helps in so many ways it helps. I think that medicine helps more than English medicine, I believe but it is hard to consume you know, get, on a daily basis."- (male, UC, BO)*

Religious beliefs

The religious affiliation of the subjects predominantly included Hinduism (n=20), followed by Islam (n=4), Christianity (n=1), and other religions (n=5) such as Jainism, Zoroastrianism, and Sikhism. Although religious beliefs had a role in participants' food choices, the responses did not differ between AC and UC groups. The majority of the participants reported that religion did not affect their diabetes management. A few participants reported that they consumed vegetarian food because they practiced a "vegetarian religion," similar to their families, while others reported that their choices of foods were based on their preferences and the nutrient composition of foods. *"I don't follow any of the religious beliefs in terms of uh to eat beef or not to eat beef. It does not have to do with religion; it does have to do with the fact that it has lot of fat"- (female, UC, BO).* A few others, although born in a family that practiced vegetarianism, had started eating meat and other non-vegetarian foods later in life or after immigration. *"I'm supposed to be (vegetarian), but because I was here (U.S.) at very young age, sometimes*

circumstances put you through so I did eat some non-veg in the beginning years" – (male, AC, BO)

Four participants mentioned that religion was very important to them while one participant reported less involvement in religious affairs because it was not acquired by choice, but inherited by birth. The benefits of adhering strictly to religious beliefs as perceived by two participants were reduced stress and facilitating the avoidance of non-vegetarian foods. *"Well in a way it does because you know it cuts you out from eating a lot of these uh what they say eating more of fish or eating more of you know."- (male, UC, BO)*

When the role of religion in diabetes management was addressed, participants in the AC and UC groups reported discontinuation of religious fasting after being diagnosed with diabetes. A primary concern relative to fasting was being on "an empty stomach" for a prolonged period, inability to consume excess carbohydrates after the fasting, and discouragement by family members for health reasons. *"No. Um, well we have that one week where we don't eat any greens or anything or you fast, and I know that as a diabetic I should not fast so I don't. I still eat the greens during those eight days, only like one day I give up which you know you can have, you can go without vegetables for a day and that's not bad" - (female, AC, BO)*

Perceived diabetes enhancement foods

When asked about foods believed to be helpful with diabetes management, some UC but no AC participants specifically mentioned eggs, chicken, and fish. *"Basically fish, chicken but more than chicken actually fish helps me. And also whole wheat so usage of whole wheat and even roti, even if I make roti I use the coarse flours, we use brown rice, so trying to manage with that" – (female, UC, BO).* Participants in AC and UC groups mentioned Indian spices (cloves, cinnamon, fennel seeds, turmeric, fenugreek seeds, and neem), all vegetables especially bitter melon, fruits, whole wheat products, lentils, low fat dairy products, sugar substitutes, and nuts to be helpful for diabetes management. Two participants in the UC group and one in the AC group said that they did not believe that any specific food was independently helpful for diabetes management.

4.5.2 Environmental Factors

Influence of health care professionals and facilities, social network, and location of residence were the environmental factors that were addressed in the interviews.

Research Question (v): How does the health care system influence self-management behaviors?

4.5.2.1 Health Care System

The two themes that emerged for the influence of health care professionals and facilities were "physician expectations" and "acceptability of health care services."

Physician expectations

Regardless of glycemic control level, participants in the AC and UC groups expected the physician to be supportive and provide education about diabetes and self-management behaviors. Two participants in each group expressed that the physician should have open communication with the patients about problems and challenges related to diabetes.

UC participants were more likely than the AC group to report that physicians should follow up and guide patients [UC (11) vs. AC (2)]. In addition, a few participants in the UC group wanted the physician to provide individual attention, spend more time with them and refrain from forcing them to comply with self-management behaviors. *"They are short on time nowadays, you know. They hardly have few minutes, my doctor give me extra time, but even that should be, is not enough you know. So probably that is the best we can hope for because they are expected to see that many patients and all that"- (female, UC, AO).*

On the other hand, the AC group expected the physician to provide knowledge, support, and refinement of treatment. Participants in the AC group, who were either physicians or researchers, noted that the physicians who are not well informed about diabetes should be receptive to advanced education. *"If the patient it not aware of the problems, if they are not aware of the condition, I think the doctor should be very well informed and then tell them what the problem is to begin with. But then if the patient is aware of the condition and know what they are talking about you should at least be supportive and find out more or learn more you know, and be ready to help them out" – (female, AC, AO).* A few

others in the AC group perceived that physicians should use a multidisciplinary approach for more efficacious treatment, by working collaboratively with dietitians and exercise therapists.

Acceptability of health care services

With regard to acceptability of health care series, ten participants in the AC and thirteen in the UC groups expressed satisfaction with the treatment provided by their physician and health care facility. Participants in both groups were pleased when the following occurred: the physician allowed the patient to manage the disease with diet and exercise in lieu of prescribing medications, the health care facility or the physician called and enquired about health outside of formal office visits, the doctor advised self-management and regular HbA1c testing to evaluate control status or progress, prompt scheduled appointment reminders were provided, and referrals were made to a dietitian.

Health care was perceived to be neutral by three and two participants in the AC and UC group, respectively. *"I can give them credit so, they give whatever we ask, they give certain thing we ask...I don't have a dislikeness or I like, plus side"- (male, UC, BO)*

Two participants in the AC group specified that they were not satisfied with their health care. Since they worked in a medical or related profession, they perceived that their physicians were not as knowledgeable or experts in diabetes management. *"They (physicians) don't understand diabetes and actually when I was in practice I also didn't know what diabetes was you know" – (male, AC, BO).*

Research Question (vi): In what ways are support networks and self-management related?

4.5.2.2 Support Network

Two themes emerged for social support: "reactions to diabetes diagnosis by family" and "help from social network".

Reactions to diabetes diagnosis by family

The reactions to diagnosis by the family were similar between the two groups. The predominant reaction was expectation due to a strong family history of diabetes followed by support and concern. *"Yeah of course they were supportive and they actually warned me from the beginning that I should be careful, careful, careful. So actually because of that (diabetes) my parents both had heart problems and they even got by-pass surgery also both of them. So, right from the beginning they have been warning me to be careful, my food mainly (female, AC, AO).* Three participants in the AC and five in the UC mentioned that their family reaction to diagnosis of diabetes was minimal to none. *"I don't think they (family members) knew, It was borderline, they didn't note at all it was normal" – (male, UC, BO)*

Help from Social Network

Participants were asked about people who were helpful and supportive of diabetes management at the time of diagnosis through the time of interview. Participants in the AC group were more likely to receive support from their families at the time of diagnosis

[AC (7) vs. UC (4)]. Knowledge of the spouse, preparation of healthy foods, encouragement to eat healthy, provision of moral support for exercise, and advice from family members who were physicians or who were affected with diabetes were the primary reasons specified. Encouragement to exercise and to eat healthy foods and make healthy diet changes for the whole family was specifically mentioned by two participants in the AC group.

Two participants in the AC and four in the UC group mentioned that it was their physician or dietitian who informed them about diabetes complications and explained about diabetes self-management. One participant in the UC group mentioned that American doctors were not aware of Indian foods. Two participants in the UC group, indicated that they did not get any social support from their friends or family, especially at the time of diagnosis. *"None, just doctor gave me the medicine I took them. My husband didn't say anything; he is never very supportive either. He is like that is your problem; you got it now, that's it. He never will say anything you know. So I didn't get any help, I can't talk to my friends about that" – (female, UC, BO -122)*

When asked about the person to whom participants would seek help with diabetes management when needed, the results were consistent. Participants in the AC group relied on family members primarily for help because family members were perceived as being knowledgeable, especially if they were physicians, or had diabetes. Participants in the AC group were more likely to have a family member with a medical background. Two participants in the AC group were researchers in the biomedical field, three were

physicians (versus one in the UC group) and three had physicians in their immediate family (versus one in the UC group). "*Again, like I said you know, a lot of physicians in the family so they are like friends or cousins whatever you want to call and everybody had a nice input and we just have been blessed that there is different expertise in the family all around*"- *(male, AC, BO-129).* Seven participants in the AC group said they would go to the physician if they required help; however, three said the physician would be their second choice next to family. Five participants in the AC group were of the opinion that they did not need any help because they had learned to manage the disease by themselves.

With regard to the UC group, eight participants said that they would go to their physician first so that the physician could check their medications and medical record, if the physician was an Asian Indian. "*Um, my doctor. I mean there is one Indian lady now, she is pretty good... she gives me tips on what Indian food is bad and how much this and that and that kind of stuff – (male, UC, BO -116).* The response from two individuals who mentioned that they would seek the physician's help suggested that physician interaction was routine medication prescription and/or adjustment as well as generalized non patient centered advice such as to follow a healthy diet and /or exercise. It was not perceived as being "supportive" per se. Friends and family were reported by two participants. Two participants indicated that they did not need help from anybody because they believed that their diabetes had not progressed to an advanced stage, which would then require help from others.

Research Question (vii): How does location of residence influence self-management behaviors?

4.5.2.3 Location of Residence

The place where the participants resided was reported as calm, safe, and peaceful by all the participants. Neighbors and friends were perceived as approachable and friendly with the exception of one participant in the UC group. Two themes emerged for location of residence: "accessibility to health care and exercise facilities and other influences" and "influence of support network."

Accessibility to health care and exercise facilities and other influences

Accessibility to health care and exercise facilities and weather were perceived to be both helpful and hindering factors for diabetes management, respectively. Proximity to health care and exercise facilities was mentioned by a few participants in both groups, as facilitators of diabetes management. *"Actually health care is very nearby so whenever I want I can go...luckily I got a gym nearby so I can go by walk itself. In my leasing office itself we have a gym so now in this climate we cannot go out for walk" – (female, AC, AO).*

Participants in the AC group were more likely to indicate Michigan weather as a major limiting factor to regular exercise [AC (6) vs. UC (1)]. *"No because you're in Michigan and you're tied down half the winter (laughing). Place of work may help but not place where I live, I should say" – (female, AC, AO).* In addition, a few participants in both the

AC and UC groups, who owned a house, perceived that working in their backyard provided physical activity, which helped their diabetes management. "W*e have a nice big yard so it keeps me busy in taking care of the yard and uh...since there is a good area I can walk in the area in summer" – (male, UC, AO).*

Influence of support network

Participants reported that they often attended Asian Indian community gatherings in the city and lived in a neighborhood where they had at least a few to many Asian Indians. Institutions where participants worked, neighbors and friends in their locality and social events appeared to be important influential factors. Four participants in the AC group mentioned that they obtained diabetes awareness through the institution where they worked, which helped them to manage their diabetes more than the location of residence because they worked in medical or research field. *"Well I work in a medical field so most of the time I get lots of help through the, my work place and my doctor and some family doctors whom we know" – (female, AC, BO – 127).* A few participants in the AC group said their friends who lived in the same neighborhood accompanied them while walking, and one participant in each group reported that they would meet with their Indian friends often and eat healthy foods.

A few participants in both groups expressed concerns about other Asian Indians in their city/neighborhood. These included not taking care of their health unless there was a serious problem, their ignorance about diet and medication for diabetes, a lack of open communication about diabetes in this population, and a lack of healthy choices at Asian

Indian celebrations/ festivals. *"...they don't even know I have it. That's one thing about the Indian community nobody tells anybody anything about what they have...we don't talk much about it because most of us are kind of borderline" – (male, UC, BO).*

Research Question (viii): What do subjects perceive to be facilitators and barriers for better managing their diabetes?

4.5.3 Facilitators and Barriers to Self-management practices

4.5.3.1 Facilitators

Facilitators to diabetes management were slightly different for the UC and AC groups. Commonly expressed examples by participants in both the groups included carrying breakfast bars, substituting Indian with western foods, practicing portion control, and avoiding sweets or sweet foods. *"I don't really like sugar. If my sugar goes down, I don't know what to do because I don't, I am not used to eating chocolate, candy and those kinds of things. Plus there are these now uh breakfast bars and things which have quite high percentage of protein and they are vegetarian and I carry them anywhere and that has been of great help" – (female, UC, BO).*

In addition to the above, AC participants mentioned making changes as a family, learning/comparing self-management practices from family members with diagnosed diabetes, reading food labels, and purchasing healthy foods when shopping. *"So for my morning breakfast earlier I could eat Indian cookies...now I don't, because I know about those things, what's right and what's wrong so I try to. The easiest thing I find is I know*

what food choices I can make. So certain things are very easy, I buy some cereals that are good for me, very low in sugars, I read the labels. I eat oatmeal, I eat more fruits and vegetables"- (female, AC, AO)

4.5.3.2 Barriers

There were more barriers than facilitators to diabetes self-management perceived in this sample of Asian Indians. Food and healthy eating was a primary factor of concern. The majority of participants in both groups mentioned several barriers to eating healthy foods [AC (8) vs. UC (10)]. Cooking special healthy meals for diabetes, avoiding food temptations especially sweet foods and sweets, difficulties in making healthy food choices/ practicing portion control when socializing were key barriers in both the AC and UC groups.

A key cultural contributor to the challenges of eating as recommended was hospitality of Asian Indian friends, during social visits. Additionally, participants in the UC group also mentioned irregular mealtimes, busy lifestyles, availability of refined foods (e.g. refined vs. whole wheat flour) at home, frustration when blood glucose remained unchanged despite "healthy" food consumption, and difficulties in assessing carbohydrates in Indian foods as limiting factors. *"...sometimes you know we cannot eat our meal in time because busy life, yes and you know we have to prepare food whatever time permits you know. Like sometimes uh, we don't have salad available every time in the house, you know. So*

but we always have some wheat flour, rice and everything in the house so it is easy to prepare food like that you know like dal, and roti and so" – (female, UC, AO – 117)

Physical activity barriers were more evident in the UC than the AC group [UC(7) vs. AC(3]. Exercise inconsistency due to busy lifestyles and weather were mentioned by participants in the AC versus lack of time, lack of motivation, bodily discomforts such as fatigue and tiredness, and preference for sedentary hobbies by the UC group. *"Exercising is number one, I would say and then monitoring my blood sugar. I guess, exercising I am just too busy or I don't give it enough time and monitoring, I'm just too lazy" – (male, AC, AO – 107)*

Two participants in the UC group mentioned that medications were a problem because they take multiple medications for diabetes as well as other conditions. In addition, adjusting insulin doses when the carbohydrate content of Indian foods was not known was also deemed challenging. *"... if you take more carbohydrates then your supposed to take more insulin, but problem that happens with Indian food is it is very difficult to measure the carbohydrates, you know. All you are just guestimating most of the time like the sugar should be like if you eat um paratas suppose you know, how many carbs does it have? So, you make an error, I try to make an error on the high side...and that's probably the reason why I'm having this difficulty in not going below 7(HbA1c), because I must be not calculating properly" – (male, UC, BO – 130)*

Three participants in the AC and one in the UC group mentioned barriers to self-monitoring blood glucose. Pain, forgetfulness, and laziness followed by availability of a glucometer, personal/business travel, and inconvenience of place of business were predominant reasons for not self-monitoring blood glucose in both groups. *"No, no, normally I am out for the meeting, occasionally I forget. Meeting times, I don't carry glucometer with me so unless I'm at home I don't do it" – (male, UC, BO -128).* Stable blood sugar in the AC versus aversion to and frustration with the glucometer readings in the UC group were perceived as additional reasons for not monitoring blood glucose. *"Um, its just stable so I'm not doing it, in fact I think it's been a long time now because I don't have the right uh, instrument, or the lancet was missing, there was a part missing and I have to go and pick it up and of course I was busy" – (female, AC, AO)*

Inadequate understanding of the laboratory tests performed, a busy schedule, and insufficient communication with the physician were barriers to regular consultation with a physician. One participant in the AC group did not like to go to the physician as often because of the belief that unnecessary tests were recommended. On the other hand participants in the UC group felt that they were not able to efficiently communicate with their physicians due to limited time and help from the physicians. There was a more generalized perceived lack of confidence in knowledge about Asian Indian foods by American physicians as clearly expressed by one person from the UC group. *"...they (American doctor) didn't know what kind of food and all that we eat so that was one of the problem and still is because our food has got enough calories"- (male, UC, BO)*

One participant in the AC group and four in the UC mentioned other barriers to self-management such as old age, a lack of motivation, reluctance to acknowledge seriousness of the disease, and a false perception that lack of symptoms signified that all was well. *"I would say, the most difficult part is I can't stay younger because I do believe the body ages and all the organs, they age. So, my metabolism has changed now and so how to fix that, that is the problem. How to fix, you know" – (male, AC, BO).*

4.5.4 Revisiting the Objectives of the Study

The objectives of this study were to determine if and how acculturation is associated with diabetes control, and to describe and contrast self-management behaviors and related factors of Asian Indian adults with physician diagnosed diabetes and who were either in acceptable glycemic control (AC) (HbA1c< 7%) or unacceptable glycemic control (UC) (HbA1c≥ 7%). In our multiple linear regression analysis, the interaction between acculturation and participants' BMI, diabetes duration, and annual household income were significant predictors of increased blood HbA1c levels, and hence glycemic control. Participants in the AC group were more likely to follow a healthy diet for diabetes management and indulge in regular physical activity for a longer duration. Through exploratory qualitative questions, environmental (neighborhood, social and health care support) and individual factors (lifestyle changes after immigration), which influenced self-management behaviors and some of the barriers and facilitators specific to Asian Indian immigrants were identified.

CHAPTER 5

DISCUSSION

In this sample of Asian Indians with physician diagnosed type 2 diabetes, interactions of annual household income, BMI, and diabetes duration with acculturation status were both statistically significant and positive, which indicates that the relationship between acculturation and glycemic control is determined by the specific values of these predictors (annual household income, BMI, and diabetes duration). Other key findings showed that participants in the UC group were more likely to experience difficulties in performing the ADA recommended self-management behaviors. Data from qualitative questions highlighted environmental and personal barriers, while social (family, institution, and neighborhood) and health care support appeared to be facilitators to recommended diabetes self-management behaviors.

5.1 Individual Factors

Personal factors (old age, busy lifestyles, lack of motivation to exercise, as well as pain and laziness to self-monitor blood glucose), extent of acculturation, diabetes knowledge, and perceived diabetes enhancement foods were the individual factors that emerged as primary influences on diabetes self-management behaviors of participants.

Inability to resist food temptations and regulate portion sizes influenced dietary compliance, especially among those in unacceptable glycemic control. Similarly, lack of time and motivation and physical discomforts were predominant reasons for non-

adherence to a regular exercise regimen. Laziness, inability to tolerate pain, and aversion towards pricking fingers determined the frequency of self-monitoring blood glucose. In addition, personal experiences of participants were determinants of compliance with regard to self-monitoring of blood glucose e.g. participants assumed their blood glucose to be at a certain level based on their food intake (both AC and UC groups) or had an aversion to monitor blood glucose because of frustration and dissatisfaction due to high blood glucose readings (UC group). Our findings are consistent with other qualitative studies on individuals with diabetes, which have documented similar barriers to diabetes self-management. These include helplessness and frustration due to a lack of glycemic control despite perceived adherence to self-management behaviors (Nagelkerk et al., 2006), lack of time or opportunities and physical discomforts which prevent increased/regular physical activity (Lawton et al., 2006), occasionally succumbing to food temptations (Gazmararian et al., 2009), and dislike towards pricking fingers and frustration with negative results of self monitoring of blood/urine glucose (Lawton et al., 2004).

In their systematic review of literature pertaining to healthy coping in diabetes management, Fisher et al (2007) identified that diabetes and its treatment were linked to various emotions such as stress, depression, anxiety, and motivational factors, which appeared to influence metabolic control and diabetes self-management. In our study, stress, depression, old age, and denial of the disease emerged as additional barriers to self-management behaviors. Diabetes (medical and psychological aspects) may affect the health-related quality of life, which in turn when impacted due to diabetes may have a

negative impact on diabetes self-management, thus exhibiting a bidirectional effect (Polonsky, 2002).

One of the important objectives of our study was to examine if and how acculturation was related to glycemic control in Asian Indian adults with diabetes. The acculturation level of participants with the use of the SL-ASIA instrument was not high, consistent with the findings of Vatrapu (2006), who documented a mean acculturation value of 2.08 ranging from 1.80 – 2.47 (below the bicultural value of 3.0) on first generation (foreign-born immigrants) Asian Indians in the U.S. A larger proportion of males and participants, who had resided in the U.S. for a longer period of time, were likely to be in the BO and UC groups, although these findings were not statistically significant, probably due to the small sample size characteristic of qualitative studies. This may be a critical consideration pertaining to glycemic control of Asian Indians because Mooteri et al (2004) documented male gender and a longer stay in the U.S. as predictors of coronary artery disease among 527 first generation Asian Indians in the U.S. Given the strong link between type 2 diabetes and cardiovascular disease, it would be important to investigate diabetes control in this high risk subpopulation.

In our multiple linear regression analysis, interactions of diabetes duration, BMI, and annual household income with acculturation status were both statistically significant and positive. The relationship between acculturation and HbA1c is therefore dependent on annual household income, BMI, and diabetes duration in this sample. The direction of the association between acculturation and HbA1c is therefore determined by the specific

values of the other three predictors. In other words, only when all of the other predictors (annual household income, BMI and diabetes duration) have the value zero, greater acculturation will lead to lower HbA1c values.

Interestingly, a study on first generation Arab immigrants from the Middle East who moved to the state of Michigan, in the U.S. documented lack of acculturation to be a risk factor for diabetes (Jaber et al., 2003). In this study Arab immigrant men with diabetes were less likely to be integrated to the U.S. compared to those without diabetes (Jaber et al., 2003). The San Antonio Heart study showed increased acculturation to be associated with a decline in both obesity and diabetes in Mexican-Americans (Hazuda et al., 1988). Similarly, Mainous et al (2006) showed low acculturation assessed by language (Spanish vs. English speaking) to be significantly associated with increased likelihood of having diagnosed diabetes and peripheral neuropathy. However, these studies assessed the relationship between acculturation and the risk for diabetes, while our study focused on glycemic control. There might be implications for glycemic control, which might be more clearly depicted in a larger quantitative study.

Lack of modification of a traditional high carbohydrate and high fat diet to healthy versions by Asian Indians could be cultural determinants of HbA1c levels (Raj et al., 1999). This was suggested in the qualitative data where although majority of the participants regardless of acculturation and glycemic control groups indicated that they made a few dietary changes such as reducing rice consumption and including sugar free foods in their diet, participants more typically in the BO group alluded to the fact that

they made healthy modifications to Asian Indian recipes, included dietary protein from animal sources such as meat and eggs, and made use of the healthy non-Asian Indian foods available in the U.S.

In our study, the relationship between acculturation and HbA1c levels was dependent on the annual household income of the study participants. Diabetes prevalence has been shown to be associated with low income status (Cuasay et al., 2001; Martinez et al., 2007; Rabi et al., 2006). In general, lower income status may place individuals at a disadvantage from health insurance and access to health care facility perspective (Guimaraes et al., 2009; Kwan et al., 2008; Levine et al., 2009). Low-income status, as specified in these studies conducted in the U.S., was categorized as income below $35,000. Since our sample was relatively from a high income group for the most part with only two people with an annual household income less than $50,000, all the participants in our sample had health insurance coverage. Therefore the study sample cannot be compared to low-income populations that are typically discussed in literature.

In our sample, about half of the participants had lived in the U.S. for over 30 years, had diabetes for less than ten years, and were over 60 years of age. Therefore, the fact that the interaction of diabetes duration with acculturation level was significantly associated with HbA1c, could be due to individuals with a shorter duration of diabetes experiencing greater challenges with diabetes self-management behaviors compared to those who have a longer disease duration. Chang et al (2005) discussed that diabetes education could be related to the discrepancy in coping. Therefore, diabetes duration when coupled with an

increase in acculturation could potentially facilitate diabetes self-management and hence improve HbA1c levels.

We observed an association between HbA1c and the interaction of acculturation with BMI. Studies have shown that Asian Indians have a high percentage of body fat despite their low BMI increasing their risk for diabetes (Banerji et al., 1999; Raji et al., 2001; Ramachandran et al., 2004). One assumption is that dietary regimen compliance for diabetes may be low among individuals with a lower BMI, especially those with low acculturation. Therefore, lack of healthy modifications of the Asian Indian diet by AO participants compared to those who were BO in our study could be a possible explanation for this association. Furthermore, in our qualitative data, Asian Indians who were AO and in the UC group, were less likely to be physically active after immigration when compared to the AO group. Both diet and physical activity are important considerations relative to a healthy weight or acceptable BMI.

Our qualitative analysis showed that there were specific differences in dietary changes after immigration perceived by the AO and BO participants. BO participants were more likely to report increased meat consumption after immigration that was not mentioned by the AO group. Consistent with the qualitative data, in our dietary analysis, the percentage of total calories from protein was significantly higher in the BO group than the AO group. One reason Naeem (2003) pointed out for increased meat consumption by Asian Indians in the U.K. was the low cost of meat compared to many vegetables. Increased meat consumption could be due to an inclination to western foods by first generation

Asian Indian immigrants, who were more vegetarian oriented in India, but have moved towards bicultural characteristics in a western society. In addition, foods that participants believed to be helpful with diabetes management differed between the AC and UC groups. Non-vegetarian foods such as chicken, fish, and eggs were perceived to be helpful for diabetes management by participants in the BO and UC groups, who also increased their meat intake after immigration. Asian Indians continue to consume traditional foods but consumption of carbonated drinks, alcoholic beverages, ice cream, cheese, margarine, and salty snacks has also increased among the Asian Indian community in the U.S. (Nguyen, 2006). Duration of stay in the U.S. could have influenced these participants' beliefs about healthy foods because there were more participants in the BO and UC groups with a longer duration of stay in the U.S.

The majority of our study participants were aware of diabetes and related complications and self-management behaviors, which could partly be due to a strong family history of the disease in most subjects. In a qualitative study by Kalra et al (2004) on Asian Indians with cardiovascular disease in northern California, a family history of the disease contributed to the knowledge level of the participants about the cardiovascular disease risk factors and the disease (Kalra et al., 2004). In a study that used the Michigan Diabetes Knowledge Test on Kuwaiti adults with type 2 diabetes, a low educational level of participants and limited household income were associated with low knowledge about the disease (Al-Adsani et al., 2009). Our study included participants with a high income and educational level, which might have facilitated diabetes knowledge acquisition

through adequate comprehension of the diabetes education materials and affordability of diabetes resources and education classes.

Unlike other studies conducted in the U.K. on Asian Indians and South Asians, knowledge about the consequences and benefits of diabetes management appeared to be adequate in the AC and UC groups as the participants were all aware of either the short and/or long term complications of uncontrolled diabetes and the potential benefits of keeping the disease under control (Baradaran et al., 2004; Macaden, 2007; Naeem, 2003). However, there were differences in how the AC and UC groups understood the intricate details relative to self-management when participants were probed further. Participants in the AC group had an in-depth understanding about the etiology and pathophysiology of the disease and recognition of the importance of key self-management behaviors such as eating healthy, exercising regularly and medication adherence. On the other hand, responses of participants in the UC group were superficial and lacked sufficient detail. Therefore, qualitative detailed responses provided identification on how there may be discrepancies in the level of understanding, when "knowledge" appears to be evident.

According to the California food guide report (Nguyen, 2006), there is an increase in meat consumption after immigration across all Asian sub-groups, including the Asian Indian group due to the increase in affordability of meat in the U.S. versus fresh fruits and vegetables in their home country. The report documented a decline in the consumption of traditional plant based foods by Asian Indians (Nguyen, 2006). Consistent with this finding, a report by Kulkarni (2004) documented a decline in fiber

content of foods and increased meat and convenience food consumption by Asian Indians after immigration to the U.S. The fiber intake was not different between the groups in our study, but the majority of participants (n=25) consumed less than the recommended <25 grams of fiber.

It was expected that religious beliefs would be influential in participant's dietary behaviors. Studies conducted on South Asians have shown religious beliefs such as fasting during religious occasions to influence diabetes self-management practices (Macaden, 2007; Naeem, 2003). Despite participants' religious beliefs, adaptation to the U.S. lifestyle was found to be more influential in the food choices of participants. Several participants (regardless of acculturation and glycemic control groups) who came from a family that practiced vegetarianism or limited certain types of meat as advocated by their religion, reported that they changed these practices after immigration, specifically beef or pork by Hindus and Muslims, respectively due to the new environment. This might be due to the easy availability of meat products at an affordable price (Nguyen, 2006) and/or an increased exposure to foods containing meat during Indian socializing events (evident in our findings). In general, the majority of participants of this study either gradually decreased their religious beliefs after immigration or placed more emphasis on health than religion. This could be attributed to the high educational level of participants.

An Asian Indian specific practice of interest was the use of complementary/ alternative medicine for diabetes. In India, the use of non-formal medical treatment for disease is common such as naturopathy, ayurveda, homeopathy, and acupressure (Kumar et al.,

2006). This could be exacerbated by the fact that there is also evidence about the toxic contents in some traditional Asian medicines (Ernst, 2002). A case report of Arsenic poisoning was reported by Ernst (2002) in a five year old Italian boy who experienced symptoms of toxicity due to the consumption of a traditional Asian Indian unknown pills and powders prescribed by an Asian Indian healer to cure congenital bilateral retinoblastoma. It was reported that the boy was recovered completely from Arsenic poisoning after the discontinuation of traditional Indian remedies (Ernst, 2002).

The majority of the participants reported that they had faith in natural/alternative medicine and showed an interest in trying certain products because they were considered natural ways of treating the disease. A national study on complementary and alternative medication use among Asian Indians reported that 63% of Asian Indians in the U.S. had used at least one type of complementary or alternate medication such as ayurvedic and/ or homeopathic medications, as well as biologically based herbal and dietary supplements (Misra et al., 2010). Unavailability of alternate medications in the U.S. was raised as a concern in our study, and therefore potentially limited the use of these products by our study participants.

Many of our study participants also questioned the composition of these medicines in general. Even though they tried them if available, they did not want to entirely rely on them. Non-prescription medications could interact with medications prescribed by the physician and may result in potential toxic effects (Pontifex et al., 1985). It would be important that the health care professional was informed of such practices. The majority

of our study participants did not mention that they discussed the use of any alternate medications taken for diabetes or other medical conditions with their physicians. Eisenberg et al (1998) did a follow up of a national survey to study the trends in alternate therapy use in the U.S. and the extent to which physicians were informed. This study showed that in the overall sample, many patients who consulted with a physician for a medical condition also tried alternate therapies, but did not share this information with their physicians. Health care professionals should hence inquire about alternate medications especially in Asian Indian patients with diabetes.

5.2 Environmental Factors

One of the primary self-management behaviors that was impacted by environmental factors as reported by subjects regardless of acculturation or glycemic control group, was exercise. The cold climate in Michigan was touted as a deterrent to regular exercise. These findings are consistent with the findings of Lawton et al (2006), who studied the barriers to physical activity perceived by Asian Indian and Pakistani people with diabetes in the U.K. In their study, lack of time and opportunities to engage in physical activities, lack of social support for outdoor activities, obligations to family, and physical discomforts were perceived as barriers to physical activity (Lawton et al., 2006).

Presence of social support such as encouragement from friends/ relatives and accompaniment by a friend or relatives to exercise has been shown to be associated with the likelihood of increased physical activity in a cross-sectional study among U.S. adults (Brownson et al., 2001). In our sample, support from friends, family, and health care

professionals favored physical activity and other self-management behaviors. Accompaniment by friends during physical activity, and attainment of information about diabetes and important self-management behaviors from physicians in the family was evident in the AC group. Participants in the AC group specifically reported increased physical activity when social support was provided from their friends while exercising. This is consistent with the findings of a national study of minority women conducted by Eyler et al (1999), which documented low social support among women with sedentary behaviors.

While social support emerged as a major facilitator for acquiring knowledge about diabetes self-management behaviors and physical activity, influence of Asian Indian community gatherings and hospitality of Asian Indian friends were perceived as barriers especially to healthy dietary adherence. Naeem (2003) in a qualitative study conducted on men from Kashmir, India, found that frequent visits to the homes of friends was as an obstacle to a low fat or low sugar diet. In our study, a few participants in both the AC and UC groups perceived that Asian Indians in general were insufficiently aware of the health consequences of excessive dietary carbohydrate and fat consumption. Hence, social expectations and pressure to eat such foods was perceived as sometimes being challenging.

Asian Indian foods are typically rich in carbohydrates and fats (Macaden, 2007). Similar to Kulkarni's (2004) modification of Asian Indian diet for diabetes, participants in the AC group made healthy modifications in their Asian Indian diets by reducing fats, added

sugar, and carbohydrates. This pattern was also evident among participants in a study on Asian Indians with cardiovascular disease in northern California (Kalra et al., 2004). A few participants in the UC group were curious to learn, but were unaware of resources that provided education about healthy adaptations of Asian Indian foods. Hence, it appears that a lack of educational resources in this respect was more of a problem potentially than willingness to learn per se.

Varghese et al (2002) studied dietary acculturation of 132 Asian Indian immigrants in Newfoundland, and demonstrated the willingness of Asian Indians to learn about nutrient relevant information of foods. Providing information about the nutrient content of foods especially culture specific foods is therefore critical for this population. In addition a critical need by patients, who were treated with insulin for diabetes management, is the ability to adjust insulin dose based on carbohydrate content, typically high in Asian Indian foods, as stated previously. A few participants in the UC group, who were on insulin treatment, expressed concern about their ability to assess nutrient content of Asian Indian foods, which warrants an important consideration for health professionals working with this target group.

Despite the increased knowledge about diabetes and related complications, Asian Indians in both the AC and UC groups required and expected guidance from physicians either within their families or from their health care facilities. Although regular consultation with a physician was perceived as the most difficult self-management behavior by a few AC participants in our survey assessment, this perception did not affect the regular

quarterly consultations with the physician. The reduced need for physician consultation was evident in the AC group due to the availability of information and advice from physicians among their friends and family members. A few participants in the AC group, who were employed in the medical/nutrition field, also perceived that the physician did not have adequate diabetes knowledge.

A key factor relative to health professional oversight might be the food portion control. Naeem (2003) in his study on Asian Indians in the U.K. found that health professionals had failed to convince clients that dietary modifications and portion control were essential for disease management. In order to better understand the problem of inadequate healthy dietary adherence, Sohal (2008) suggested that health professionals should increase the awareness about diabetes and related complications among South Asians since they exhibited poor compliance with lifestyle changes such as diet, weight control and physical activity. Sohal (2008) also advocated culture and language specific community-based multidisciplinary approaches because of the serious diabetes-related and cardiovascular disease risk implications in this population.

5.3 Implications for Future Research

This study explored acculturation relative to glycemic control and the factors influencing diabetes management among Asian Indians in the U.S. The findings demonstrated that lifestyle changes such as dietary and physical activity behaviors are important factors to consider in this target group. Therefore, lifestyle interventions should include nutrition education of culture specific foods. More specifically, resources for Asian Indian patients

are needed such as information about nutrient content of Asian Indian foods specifically carbohydrate content of Asian Indian foods to facilitate insulin dosage adjustment for patients on insulin treatment (Davachi et al., 2005).

Findings of this study also heightened the need for health professional awareness of the importance of social support when interacting with Asian Indian patients with diabetes. Friends/neighbors, health professionals, and family members of participants appeared to be trusted sources of help when needed as well as potential barriers to self-management behaviors. Health care professionals should spend adequate time soliciting social support information, guiding the patients as well as involve the family.

The high prevalence of diabetes in urban India (Mohan et al., 2008; Ramachandran et al., 1992; Singh et al., 1998) makes one wonder if translocation from rural to urban regions in India, could have similar effects as immigration to another country. A study by Ramachandran et al (1999) had documented the association between increasing diabetes prevalence and sedentary lifestyle among Asian Indians residing in a peri-urban region (city outskirt with easy access to urban facilities) in Chennai, India. Residents' dietary habits were similar to that of urban compared to the rural population. Future studies should explore how acculturation in other countries compares with urbanization, in order to refine and tailor existing interventions for the improvement of glycemic control for immigrants as well as urban migrants in India.

Asian Indians in our study tended to perceive that American physicians were not aware of ethnic-specific foods. Increased awareness and open communication of the patient-health care provider about cultural barriers to adherence to self-management is critical for achievement of glycemic control. There is a need for healthcare professionals to address culture-specific community-based multidisciplinary approaches to the optimal management of diabetes in this population (Sohal, 2008). A previous study on Pakistani women in Melbourne, Australia documented successful treatment of metabolic syndrome via culturally relevant interventions (Kousar et al., 2008). Therefore, culturally relevant strategies are essential for efficacy of intervention for the immigrant population (Kreps et al., 2008; Nguyen et al., 2006).

5.4 Strengths and Limitations

This was the first study to explore via a mixed quantitative-qualitative approach, the relation of acculturation and self-management of type 2 diabetes in Asian Indians in the United States. Dietary intake and acculturation level of participants were assessed using validated instruments, which added strength to the methodology. Both qualitative and quantitative methods were used to assess self-management behaviors and acculturation level of participants. Data obtained by the two approaches were triangulated, which facilitated validation of assessment methods and checking for consistency. Qualitative data was coded independently by two researchers and coding consensus was obtained to minimize bias. Since the primary researcher belonged to the same ethnicity, participants were comfortable and more willing to disclose dietary and survey information, which facilitated rapport with the participants as recommended by Vatrapu (2006).

In keeping with qualitative methodology, interviews were conducted until data saturation. Although findings from a qualitative approach provided rich information, careful interpretation of quantitative analysis should be performed due to the limited sample size. Therefore, the inferential analysis of quantitative data may not be as conclusive due to insufficient power. This sample was relatively homogenous consisting of Asian Indians with a high education status and household income. Therefore the findings of this study may differ for a more heterogeneous sample. Since this was a convenience sample confined to Michigan, findings of this study (e.g. climatic barrier to exercise) cannot be generalized to all Asian Indians in the U.S. or other countries.

5.5 Recruitment Challenges

Recruitment of participants was a challenge although the study was advertised through various Indian organizations. Participants were therefore also recruited through a snowballing method i.e. through participant referrals of other potential participants. Initially, the study was intended to be conducted in Lansing, Michigan. However, due to a minimal response from interested participants in Lansing, participants who met eligibility requirements were also recruited from other cities such as Detroit, Ann Arbor, and Novi.

5.6 Summary and Conclusions

This study provided a snapshot of the relationship between acculturation and glycemic control and the factors influencing diabetes self-management behaviors of Asian Indians in the U.S. Although the socio-demographic characteristics of the participants in the AC

and UC groups did not differ, more rigid adherence to self-management behaviors, especially lifestyle/behavior changes (e.g. performing frequent exercises for a longer duration, following a special diet for diabetes, and consulting the physician on a regular basis) was reported by participants in the AC group. The majority of participants in the AC group perceived performance of self-management behaviors to be easy, while perceived challenges (e.g. inability to control dietary portion sizes, lack of motivation to exercise, pain and aversion to self-monitor blood glucose) in performing the self-management behaviors on a regular basis was higher among participants in the UC group.

Participants in both the AC and UC groups were aware of diabetes and related complications; however, the knowledge level of AC participants about the disease mechanism was superior to that of UC participants. Besides these differences, a few participants in both the groups perceived dietary and exercise management as safe and were reluctant to manage diabetes with insulin or oral diabetes medications due to an aversion to insulin therapy (psychological insulin resistance) and potential side effects of oral diabetes medications.

Although participants in both the groups questioned the efficacy of complementary/ alternative medications, they exhibited a tendency to believe in and willingness to try them for diabetes or other medical conditions. Support received from family members, health care professionals within friends/ family, neighbors and friends, and the influence of institutions where participants worked appeared to be important influencing factors that facilitated awareness about the disease and self-management behaviors. In addition,

UC participants were more likely to expect physician time and attention while the AC participants expected increased knowledge and refinement of treatment from the physicians.

Culture specific barriers to dietary adherence were specified by the study participants such as challenges in counting carbohydrate content of Asian Indian foods, difficulty in adjusting medications based on Asian Indian foods, and inability to communicate with the American physician about Asian Indian foods. Furthermore, a lack of healthy food choices at Asian Indian celebrations/ festivals, ignorance of Asian Indians about healthy foods and health, hospitality of Asian Indian friends during social visits, and a lack of open communication about diabetes among Asian Indians were additional concerns pertaining to other Asian Indians. Adherence to healthy eating during the weekends and when socializing was also perceived as a challenge by our study participants.

An interaction between acculturation and individual factors (diabetes duration, BMI, and income) was observed, which significantly influenced glycemic control. Our study findings indicate that participants' annual household income, diabetes duration, and BMI determined the direction of association between acculturation and HbA1c levels among Asian Indians in the U.S. Increased health awareness and decreased physical activity after immigration to the U.S. by a few participants in the AC and UC groups, respectively, were evident in the findings from the qualitative data.

Participants in both the groups perceived that improved exercise and health care facilities, quality of healthy food choices, availability of self-monitoring devices, and medical insurance were favorable for diabetes management in the U.S. These findings suggest that the host environment coupled with increased health awareness and social support might have facilitated health promoting behaviors of participants. Therefore, diabetes interventions that target this group should address social support, culture specific lifestyle barriers, and provide awareness about the importance of strictly adhering to self-management behaviors.

APPENDICES

Appendix A: Michigan State University Institutional Review Board Approval

MICHIGAN STATE
UNIVERSITY

Revision Application Approval

October 17, 2008

To: Lorraine WEATHERSPOON
334 Trout FSHN Bldg
MSU

Re: **IRB# 08-593** Category: EXPEDITED 5, 6, 7
Revision Approval Date: October 14, 2008
Project Expiration Date: July 18, 2009

Title: Acculturation and Associated Factors in Relation to Glycemic Control and Self-management of Diabetes in Asian Indian Adults in the United States

The Institutional Review Board has completed their review of your project. I am pleased to advise you that **the revision has been approved.**

This letter notes approval for the revised preliminary questionnaire & interview guide.

The review by the committee has found that your revision is consistent with the continued protection of the rights and welfare of human subjects, and meets the requirements of MSU's Federal Wide Assurance and the Federal Guidelines (45 CFR 46 and 21 CFR Part 50). The protection of human subjects in research is a partnership between the IRB and the investigators. We look forward to working with you as we both fulfill our responsibilities.

Renewals: IRB approval is valid until the expiration date listed above. If you are continuing your project, you must submit an ***Application for Renewal*** application at least one month before expiration. If the project is completed, please submit an ***Application for Permanent Closure***.

Revisions: The IRB must review any changes in the project, prior to initiation of the change. Please submit an ***Application for Revision*** to have your changes reviewed. If changes are made at the time of renewal, please include an ***Application for Revision*** with the renewal application.

Problems: If issues should arise during the conduct of the research, such as unanticipated problems, adverse events, or any problem that may increase the risk to the human subjects, notify the IRB office promptly. Forms are available to report these issues.

Please use the IRB number listed above on any forms submitted which relate to this project, or on any correspondence with the IRB office.

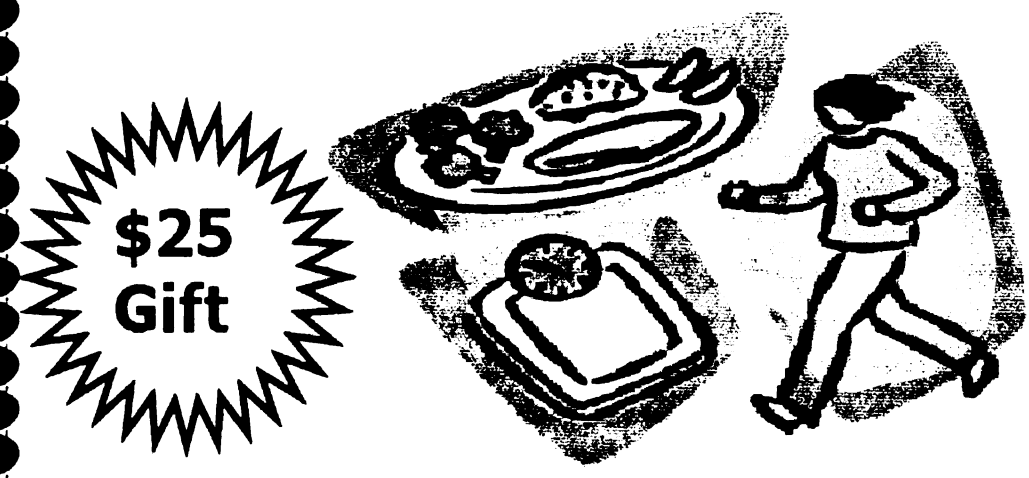
Good luck in your research. If we can be of further assistance, please contact us at 517-355-2180 or via email at IRB@msu.edu. Thank you for your cooperation.

Sincerely,

Ashir Kumar, M.D.
BIRB Chair

Appendix B: Recruitment Flyer

Are you a person of Indian origin?
Do you have sugar diabetes?
Do you know that diabetes affects as many as 1 in 5 Indians in the US?



Would you like to help us understand how you manage your diabetes?

We invite you to participate in a research study to help us better understand how Indians in the US manage their diabetes. As a thank you for your participation, you will receive a $25 gift card to Meijers.

If you are interested in participating in this important project, please contact Sumathi Venkatesh at:

Phone: (517) 355-8474 ext. 164
Email: venkate6@msu.edu

MICHIGAN STATE UNIVERSITY

Appendix C: Letters of Support
ICS India Cultural Society

To The Institutional Review Board at Michigan State University:

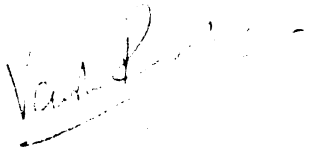
This letter is to inform you that the India Cultural Society (ICS) gives permission to Lorraine Weatherspoon Ph.D., R.D., and Sumathi Venkatesh from Michigan State University, 332 GM Trout FSHN Building, East Lansing, MI 48823 to,

1. Give information regarding their diabetes oriented research in the ICS newsletter. ICS may also forward this to its members via email so that any interested ICS members can contact Sumathi directly.
2. Post flyers at ICS events (upon coordination with the ICS Board).
3. Attend scheduled ICS events to display their research study titled "Acculturation and associated factors in relation to Glycemic control and self-management of Type 2 diabetes in Asian Indian adults in the United States".

The ICS Board has yet to read their research summary and will be unable to do so until the next Board meeting. However, the ICS Board considers this to be a community cause and is willing to help them use ICS channels to conduct their educational research. We have requested them to refrain from soliciting for funds through the ICS media. Please contact Anu Deshpande at 5173406642 or me at 5173935905, should you have any further questions or can provide us with any more information.

Thanking you.

Sincerely,



Vaishali Rajput

President, ICS

Appendix C: Letters of Support (cont.)
Bharatiya Temple of Lansing, Inc.

To:
Michigan State University
Institutional Review Board
202 Olds Hall
East Lansing, MI 48824

May 25, 2008

Dear Institutional Review Board at Michigan State University:

This letter is to inform you that, on behalf of the Board of Trustees of Bharatiya Temple of Lansing, I give permission to Lorraine Weatherspoon Ph.D., R.D., and Ms. Sumathi Venkatesh from Michigan State University, 332 GM Trout FSHN Building, East Lansing, MI 48824 to:

- ❑ Post flyers at religious/ meeting places designated for the community information
- ❑ Attend scheduled major events at our Temple for awareness and volunteer recruitment

for the research study titled "Acculturation and associated factors in relation to Glycemic control and self-management of Type 2 diabetes in Asian Indian adults in the United States." I have read the research proposal and agree to have Sumathi Venkatesh contact members of our organization by above means ONLY for her research purpose. You can contact me directly at the Temple address given above or call me at 517-862-9683 if you have any questions.

Sincerely,

Rajiv nDas

(Rajiv R. Das)
Chair,
On behalf of Board of Trustees

Appendix C: Letters of Support (cont.)
Lansing Tamil Sangam

Michigan State University
Institutional Review Board
202 Olds Hall
East Lansing, MI 48824

Sudarsan Vaithu / Thangavelu Suseela
Lansing Tamil Sangam

May 26, 2008

Dear Institutional Review Board at Michigan State University:

This letter is to inform you that Lansing Tamil Sangam gives permission to Lorraine Weatherspoon Ph.D., R.D., and Sumathi Venkatesh from Michigan State University, 332 GM Trout FSHN Building, East Lansing, MI 48823 to:

(i) send information and electronic flyers to Lansing Tamil Sangam board members to forward to their members
(ii) post flyers at religious/ meeting places
(iii) attend scheduled major events for personal recruitment

for the research study titled "Acculturation and associated factors in relation to Glycemic control and self-management of Type 2 diabetes in Asian Indian adults in the United States". I have read the research proposal and agree to have Sumathi Venkatesh contact members of our organization who respond to our emails for her research purpose. You can contact me directly at the above address or call me at 517-402-3368/517-256-5345 if you have any questions.

Sincerely,

T. Suseela

Thangavelu Suseela
Board Member
Lansing Tamil Sangam

Appendix C: Letters of Support (cont.)
Michigan Asian Indian Family Services

Michigan State University
Institutional Review Board
202 Olds Hall
East Lansing, MI 48824

Michigan Asian Indian Family Services
Suburban Shared Center
32401 W.Eight Mile Rd
Livonia, MI 48152

September 18, 2008

Dear Institutional Review Board at Michigan State University:

This letter is to inform you that I give permission to Lorraine Weatherspoon Ph.D., R.D., and Sumathi Venkatesh from Michigan State University, 332 GM Trout FSHN Building, East Lansing, MI 48823 to:

(i) use our email listserv
(ii) post flyers at religious/ meeting places
(iii) attend scheduled major events for personal recruitment

for the research study titled "Acculturation and associated factors in relation to Glycemic control and self-management of diabetes in Asian Indian adults in the United States". I have read the research proposal and agree to have Sumathi Venkatesh contact members of our organization for her research purpose. You can contact me directly at 248-477-4985 if you have any questions.

Sincerely,

BRmehta

Brij Mohta (Chairperson, MAI Family Services)

Appendix C: Letters of Support (cont.)
Coalition of Indian Undergraduate Students

Michigan State University
Institutional Review Board
202 Olds Hall
East Lansing, MI 48824

1426 North Hidden Creek Dr.
Saline, MI 48176

May 26, 2008

Dear Institutional Review Board at Michigan State University:

This letter is to inform you that I give permission to Lorraine Weatherspoon Ph.D., R.D., and Sumathi Venkatesh from Michigan State University, 332 GM Trout FSHN Building, East Lansing, MI 48823 to:

(i) use our email listserv
(ii) post flyers at religious/ meeting places
(iii) attend scheduled major events for personal recruitment

for the research study titled "Acculturation and associated factors in relation to Glycemic control and self-management of Type 2 diabetes in Asian Indian adults in the United States". I have read the research proposal and agree to have Sumathi Venkatesh contact members of our organization for her research purpose. You can contact me directly at 1426 North Hidden Creek Dr. Saline, MI 48176 or call me at 734-657-5190 if you have any questions.

Sincerely,

Radhika Menawat

Radhika Menawat – President of the Coalition of Indian Undergraduate Students

Appendix C: Letters of Support (cont.)
Michigan State University India Club

Michigan State University
Institutional Review Board
202 Olds Hall
East Lansing, MI 48824

MSU India Club (MSUIC)

June 10, 2008

Dear Institutional Review Board at Michigan State University:

This letter is to inform you that MSUIC gives permission to Lorraine Weatherspoon Ph.D., R.D., and Sumathi Venkatesh from Michigan State University, 332 GM Trout FSHN Building, East Lansing, MI 48823 to:

(i) use our email listserv
(ii) post flyers at religious/ meeting places
(iii) attend scheduled major events for personal recruitment

for the research study titled "Acculturation and associated factors in relation to Glycemic control and self-management of Type 2 diabetes in Asian Indian adults in the United States". I have read the research proposal and agree to have Sumathi Venkatesh contact members of our organization for her research purpose through the above mentioned channels. You can contact me directly at rautnikh@msu.edu or call me at 517-230-3450 if you have any questions.

Sincerely,

Nikhil Raut

President MSU India Club

Appendix C: Letters of Support (cont.)
Oriental mart, East Lansing, Michigan

Michigan State University
Institutional Review Board
202 Olds Hall
East Lansing, MI 48824

Oriental Mart
2800 E Grand River Ave
East Lansing, MI 48823

September 23, 2008

Dear Institutional Review Board at Michigan State University:

This letter is to inform you that I give permission to Lorraine Weatherspoon Ph.D., R.D., and Sumathi Venkatesh from Michigan State University, 332 GM Trout FSHN Building, East Lansing, MI 48823 to post their recruitment flyers in Oriental Mart for their research study titled "Acculturation and associated factors in relation to Glycemic control and self-management of diabetes in Asian Indian adults in the United States". You can contact me directly at 2800 E Grand River Ave, East Lansing, MI 48823 or call me at (517) 337-2519 if you have any questions.

Sincerely,

Proprietor Oriental Mart

Appendix C: Letters of Support (cont.)
Swagath Foods, East Lansing, Michigan

Michigan State University
Institutional Review Board
202 Olds Hall
East Lansing, MI 48824

Swagath Foods
1060 Trowbridge Rd. Suite 1
East Lansing MI - 48823

September 23, 2008

Dear Institutional Review Board at Michigan State University:

This letter is to inform you that I give permission to Lorraine Weatherspoon Ph.D., R.D., and Sumathi Venkatesh from Michigan State University, 332 GM Trout FSHN Building, East Lansing, MI 48823 to post their recruitment flyers in Swagath Foods for their research study titled "Acculturation and associated factors in relation to Glycemic control and self-management of diabetes in Asian Indian adults in the United States". You can contact me directly at 1060 Trowbridge Rd. Suite 1, East Lansing MI - 48823 or call me at (517)333-6536 if you have any questions.

Sincerely,

Proprietor Swagath Foods

Appendix C: Letters of Support (cont.)
Sindhu Indian Cuisine, E. Lansing, Michigan

Michigan State University
Institutional Review Board
202 Olds Hall
East Lansing, MI 48824

Sindhu Indian Cuisine
4790 S Hagadorn Rd # 132
East Lansing, MI 9999

September 22, 2008

Dear Institutional Review Board at Michigan State University:

This letter is to inform you that I give permission to Lorraine Weatherspoon Ph.D., R.D., and Sumathi Venkatesh from Michigan State University, 332 GM Trout FSHN Building, East Lansing, MI 48823 to post their recruitment flyers in Sindhu Indian Cuisine for their research study titled "Acculturation and associated factors in relation to Glycemic control and self-management of diabetes in Asian Indian adults in the United States". You can contact me directly at 4790 South Hagadorn Rd # 132 or call me at (517) 351-3080 if you have any questions.

Sincerely,

9/23/08

Proprietor Sindhu Indian Cuisine

Appendix C: Letters of Support (cont.)
Asia Bazaar Indian Groceries

Michigan State University
Institutional Review Board
202 Olds Hall
East Lansing, MI 48824

Asia Bazaar
1754 Central Park Dr
Okemos, MI 48864

September 22, 2008

Dear Institutional Review Board at Michigan State University:

This letter is to inform you that I give permission to Lorraine Weatherspoon Ph.D., R.D., and Sumathi Venkatesh from Michigan State University, 332 GM Trout FSHN Building, East Lansing, MI 48823 to post their recruitment flyers in Asia Bazaar Indian groceries for their research study titled "Acculturation and associated factors in relation to Glycemic control and self-management of diabetes in Asian Indian adults in the United States". You can contact me directly at 1754 Central Park Dr Okemos, MI 48864 or call me at (517) 347-3565 if you have any questions.

Sincerely,

Proprietor Asia Bazaar Indian Groceries

Appendix D: Interview Guide

Participant ID _____Recruitment site _____Date of Interview_____

SOCIO-DEMOGRAPHIC INFORMATION

1) Date of birth_____ (mm/dd/yyyy)

2) Gender
   - ❑ Male
   - ❑ Female

3) Religion
   - ❑ Hindu
   - ❑ Christian
   - ❑ Muslim
   - ❑ Other (specify) _____

4) Educational level
   - ❑ Less than high school
   - ❑ High School
   - ❑ Bachelors
   - ❑ Masters
   - ❑ Ph. D or MD

5) In what country did you get each of the following levels of education?
   - ❑ Less than high school _____
   - ❑ High School _____
   - ❑ Bachelors _____
   - ❑ Masters _____
   - ❑ Ph. D or MD _____

6) Employment status
   - ❑ Employed (full time)
   - ❑ Employed (part time)
   - ❑ Homemaker
   - ❑ Unemployed
   - ❑ Disabled/Unable to work
   - ❑ Retired
   - ❑ Student
   - ❑ Other (specify)_____

7) If you are employed, please specify:

- ❑ Type of job _____
- ❑ No. of hours you work / day _____
- ❑ Describe the activity level of your job ☐ Heavy ☐ Moderate ☐ Light

8) Marital status

- ❑ Single
- ❑ Married
- ❑ Widowed
- ❑ Separated/Divorced

9) Approximate annual household income

- ❑ <$20,000
- ❑ 20,000 to 50,000
- ❑ 51,000 to 75,000
- ❑ 76,000 to 100,000
- ❑ >$100,000
- ❑ Other (specify) _____

10) With whom do you live?

- ❑ Alone
- ❑ With Friends
- ❑ With spouse
- ❑ With spouse and children
- ❑ With spouse and parents
- ❑ With spouse, children and parents
- ❑ Other (specify)_____

11) Type of housing

- ❑ Own House
- ❑ Rental house
- ❑ University apartments
- ❑ Other apartment
- ❑ Other (specify)_____

12) No. of members in Household_____

- ❑ Adults_____
- ❑ Children (<18 years) _____

13) Which state of India are you from? _____

14) What language do you speak at home? _____

15) How many years have you continuously lived in the US?_____ (years)

16) Have you lived in a country other than US?

- ❑ Yes (specify country) _____ for how many years? _____
- ❑ No

17) Do you have medical insurance?

- ❑ Yes (specify) _____
- ❑ No

18) Do you smoke?

- ❑ Yes (specify) for how many years? _____ no. of cigarettes _____day / week
- ❑ No

19) Do you drink alcohol?

- ❑ Yes (specify) for how many years? _____ no. of drinks _____day / week
- ❑ No

20) Of the following, please mark all that you DO NOT drink/eat?

- ❑ Milk
- ❑ Eggs
- ❑ Chicken
- ❑ Mutton / Lamb
- ❑ Beef
- ❑ Pork
- ❑ Seafood
- ❑ Other (Specify)_____

DIABETES INFORMATION

21) How long have you had diabetes? _____(Years)

22) When did the doctor first tell you that you had diabetes? _____(mm/yyyy)

23) In which country were you when you were first diagnosed with diabetes? _____

24) How did you choose the doctor you visit for diabetes care? _____

25) Have you ever received any education about your diabetes from a health professional?

- ❑ Yes (specify) _____
- ❑ No

26) Do you know if diabetes education is available to you?

- ❑ Yes (specify) _____
- ❑ No

27) How many times have you seen a doctor in the past year for your diabetes? _____

28) How many times have you had to stay in the hospital in the past year for diabetes or other conditions? Please mention all that apply:

- ❑ High Blood sugar
- ❑ Low Blood sugar
- ❑ Blood pressure
- ❑ Heart disease
- ❑ Kidney problems
- ❑ Other (Specify) _____

29) Do you have any of the following medical problems (Yes / No)

- ❑ High Blood pressure
- ❑ Heart disease
- ❑ Kidney problems
- ❑ Overweight
- ❑ Eye Problems
- ❑ Nerve Problems
- ❑ Other (Specify) _____

30) Is there anybody else in the family who has diabetes? (Yes / No)

- ❑ Father
- ❑ Mother
- ❑ Grand Parent
- ❑ Sibling
- ❑ Husband/ Wife
- ❑ Children
- ❑ Other (specify) _____

MEDICATION

31) Were you given any medication for diabetes when the doctor first told you that you have diabetes? (Yes / No)

- ❑ Insulin
- ❑ Tablets
- ❑ Both

32) What medication are you taking for your diabetes now?

- ❑ Insulin
- ❑ Tablets

- ❑ Both
- ❑ None (diet only)

33) Do you have any problems taking diabetes tablets/ injections prescribed by the doctor?

- ❑ Yes
- ❑ No

34) What do you do if you have problems taking your medication (insulin injections / tablets)?

- ❑ Take it later
- ❑ Wait until the next medicine time
- ❑ Other (specify) _____

35) Can you tell me all the medications that you take including those not prescribed by the doctor?

- ❑ For what conditions? _____
- ❑ How many other medications? _____
- ❑ Please specify the names _____

MONITORING

36) Did your doctor ask you to check your blood sugar at home? (Yes / No) How often? _____

37) How often are you able to check your blood sugar at home/ work? _____ day / week

38) If you are not able to check often, what interferes with your blood sugar testing? _____

39) Do you check it yourself? (Yes / No) If no, who helps you check your blood sugar? _____

40) Did your doctor ask you to check your feet at home? (Yes/ No) How often? _____

41) How often are you able to check your feet at home? _____ day / week

42) Do you check it yourself? (Yes / No) If no, who helps you check your feet? _____

43) Do you follow any special diet? (Yes / No) If yes, what do you do? _____

44) How often do you follow this diet?

- ❑ All the time
- ❑ Sometimes
- ❑ Rarely
- ❑ Never

45) Do you exercise? (Yes / No)

- ❑ What do you do? _____
- ❑ How long do you do it? _____
- ❑ How many times / week? _____
- ❑ What other physical activities you do each day? _____How many hours? _____

46) Are you trying to lose/ gain weight?

- ❑ Yes (specify number of pounds you want to lose/ gain)_____
- ❑ No

47) What was your weight when you were first diagnosed with diabetes? _____ (pounds / kg)

48) What is your current weight? _____ (pounds / kg)

49) What was your highest _____ (pounds / kg) and lowest adult weight? _____ (pounds / kg)

50) On a scale of 1 to 7 (1= least difficult...7 = most difficult) please rank the order in which you are able to do the following as recommended by the doctor:

_____Healthy eating

_____Weight control

_____Regular exercise

_____Foot care

_____Self monitoring blood glucose

_____Taking prescribed medicines

_____Regular check up with a doctor

PHYSICAL EXAMINATION

Date	*Height (feet and inches)*	*Weight (pounds)*

LABORATORY DATA: HbA1c

Date	*HbA1c*

HOW DOES THE PARTICIPANTS KNOWLEDGE OF DIABETES AFFECT THEIR SELF-MANAGEMENT BEHAVIORS?

1) Can you tell me what diabetes is? *Prompt: Tell me anything you know about diabetes?*

2) What do you think will happen if you do not take care of your diabetes? Why?

3) What do you think are the benefits of managing your diabetes? Why?

4) What do you think is important to take care of your diabetes? *Prompt: How did you learn this information?*

5) What do you think the role of medicine is in managing diabetes?

6) What do you think the role of food is in managing diabetes?

7) What do you think the role of exercise or physical activity is in managing diabetes?

8) You told me about the roles of food, medicine and exercise, do you think that one is more important than the other? How?

HOW DO PARTICIPANTS PERCEIVE THE IMPACT OF THE DISEASE AND THE REQUIRED SELF-MANAGEMENT BEHAVIORS?

9) Can you tell me how having diabetes has changed your life? What do you do differently now? *Prompt: After being diagnosed with diabetes how has your daily routine changed?*

10) What do you do on a daily basis to take care of your diabetes? How do you feel about it? *Prompt: Exercise, medical care, diet, testing blood sugar, foot care?*

IN WHAT WAYS ARE SUPPORT NETWORKS AND SELF-MANAGEMENT RELATED?

11) When you first found out you had diabetes, who was the most helpful and how? *Prompt: family, friends, doctor etc.*

12) How did your family respond or react when you first told them that you had diabetes? *Prompt: Can you give me an example? Were they supportive of it? Did they help in your diabetes management? If so, how?*

13) When you need help with your diabetes, to whom do you go to and how do they respond? *Prompt: Friends, family, doctor etc.*

14) If you have relatives or friends with diabetes, how do you think having diabetes is the same or different for you compared to your family member or friend with diabetes? *Prompt – can you give me some examples?*

WHAT DO PARTICIPANTS PERCEIVE TO BE FACILITATORS AND BARRIERS FOR SELF-MANAGEMENT BEHAVIORS?

15) What are some of the difficulties in managing your diabetes? *Prompt: What are some things that you don't do well? What makes it difficult for you to do these well?*

16) What helps you in taking care of your diabetes? *Prompt: What are some of the things you do well with regard to managing your diabetes? What makes it easy to do?*

HOW DOES LOCATION OF RESIDENCE INFLUENCE SELF-MANAGEMENT BEHAVIORS?

17) Can you tell me about the area/ neighborhood where you live? Are there many Indians nearby? *Prompt: What do you think about the Indian community? Are they friendly, helpful?*

18) Can you tell me how the place where you live helps you to manage your diabetes? *Prompt: For e.g. access to health care, physical activity, diet, friends etc.*

19) Can you tell me how the place where you live prevents you from managing your diabetes? *Prompt: For e.g. access to health care, physical activity, diet, friends etc.*

HOW DOES THE HEALTH CARE SYSTEM INFLUENCE SELF-MANAGEMENT BEHAVIORS?

20) What do you feel about the health care that you receive from your clinic or doctor? *Prompt: What do you like or dislike? Why?*

21) What do you think the role of doctor should be in helping you with your diabetes?

HOW DOES AN INDIVIDUAL'S VALUES AND BELIEFS INFLUENCE SELF-MANEGEMENT BEHAVIORS?

22) Can you tell me if you manage your diabetes with any other Indian treatment such as Ayurveda, Unani, Siddha, Homoeopathy, and Yoga etc?

23) What are foods that you don't eat based your religion? *Prompt: Do you fast on some days for religious purposes?*

24) What are some of the foods or other things that you believe help you with your diabetes? *Prompt: What are they? Tell me how they/it help/s you?*

IS ACCULTURATION RELATED TO GLYCEMIC CONTROL, AND IF IT IS HOW?

25) How do you think your food habits, physical activity and other daily routines have changed after coming to the U.S.? *Prompt: What are some things you did in India but are not doing here and vice versa*

26) Are there any special difficulties/ benefits in taking care of your diabetes in the US when compared to India? *Prompt: How different do you think it would be if you were to take care of your diabetes in India?*

27) Anything else you want to tell me about your management of diabetes?

Appendix E: Preliminary Interview Guide

Date of Interview_____ Participant ID _____

Participant Name _____Age_____ Male Female

Address_____

_____ Phone number_____

1) How long have you lived in the US? _____

2) Were you diagnosed with diabetes by a doctor?

- ❑ Yes (specify when) _____
- ❑ No

3) If yes, how was this diagnosis made from what you remember? _____

4) Do you know what is the HbA1c test?

- ❑ Yes (can you explain?)_____
- ❑ No

If the answer is no or is incorrect: *The investigator will explain that it is a blood sugar test taken in the doctor's office or at a laboratory facility that will tell you how your blood sugar was maintained during the past 3 months.*

5) Did you have HbA1c blood sugar test taken within the past one year?

- ❑ Yes (specify when)_____
- ❑ No

6) Do you have the HbA1c report with you?

- ❑ Yes (specify value) _____
- ❑ No

7) Will you be able to provide us a copy of your HbA1c report?

- ❑ Yes
- ❑ No

8) Will you be able to participate in an interview conducted in English?

- ❑ Yes
- ❑ No

For females

9) Are you pregnant/ breastfeeding?

- ❑ Yes
- ❑ No

Appendix F: Participant Consent Form

Research Participant Information and Consent Form

You are being asked to participate in a research project. Researchers are required to provide a consent form to inform you about the study, to convey that participation is voluntary, to explain risks and benefits of participation, and to empower you to make an informed decision. You should feel free to ask the researchers any questions you may have.

Study title: Acculturation and Associated Factors in Relation to Glycemic Control and Self-management of Diabetes in Asian Indian Adults in the United States

Researchers and Titles: Lorraine Weatherspoon PhD, RD
Associate Professor in Human Nutrition &
Director, Didactic Program in Dietetics

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Sponsor: Lorraine Weatherspoon PhD, RD
Associate Professor in Human Nutrition &
Director, Didactic Program in Dietetics

PURPOSE OF RESEARCH:

You are being asked to participate in a research study that will help us understand Acculturation and Associated Factors in Relation to Glycemic Control and Self-management of Diabetes in Asian Indian Adults in the United State. You have been selected as a possible participant in this study because you contacted the researcher showing interest in participation in this research project. From this study, the investigators hope to learn how living in the United States of America and other factors are related to how Asian Indian adults are able to manage their diabetes. Diabetes management practices include testing blood sugar between doctor visits, exercising regularly, following dietary recommendations, taking prescribed medicines, weight control, regular foot care and visiting with the doctor. In the entire study, approximately 30 people are being asked to participate. Your participation in this entire study will take about 2 to 2.5 hours.

WHAT YOU WILL DO:

This study consists of four parts after we ask you the preliminary questions to see if you are eligible to participate in the study. First we will ask questions about how living in the United States of America has influenced your habits. Secondly, we will ask about the foods you have eaten in the past 24 hours. These two parts will take about 45 minutes. The third part will consist of an audio-recorded interview lasting about an hour. This interview will include questions, which will help us to better understand

the things you experience related to diabetes as well as some additional general survey questions. We will also need to call you at a later date agreed upon with you, if you do not mind giving us your phone number, to ask you questions about how you eat over a different 24-hour period. This will take another 20 – 30 minutes and give us a clearer idea about how you eat both during the week and weekends.

POTENTIAL BENEFITS:

Your participation in this study may help you better understand how you are managing your diabetes. It may also benefit you indirectly and Indians with diabetes in the United States of America, in that health care professionals, may be able to better understand special considerations for helping Indians who have Diabetes from the information we collect.

POTENTIAL RISKS:

There are no physical procedures to your body expected of this research. Therefore, you should experience no physical risks or discomforts. However, you may feel embarrassed or shy about answering some of the questions. You are not obligated to answer anything that you would prefer not to. There will be no penalty, if this is the case.

PRIVACY AND CONFIDENTIALITY

The interview will be done in a convenient place for you with complete privacy. Information about you will be kept confidential to the maximum extent allowable by law. Each subject will be given an identification number that will be on a log sheet with their corresponding names and contact information. This log sheet will be used only for assignment of identification numbers and contact purposes if and when necessary. All data will only have identification numbers with no personal identifiers. Log sheets and data will be kept in separate locked filing cabinets. Only the primary investigators L.Weatherspoon and Sumathi Venkatesh will have access to participant's personal identification information. Data with identification numbers only and audio recordings will be accessible by L.Weatherspoon, S.Venkatesh and a trained undergraduate research assistant for data analysis purposes. The results of this study may be published or presented at professional meetings, but the identities of all research participants will remain anonymous.

YOUR RIGHTS TO PARTICIPATE, SAY NO, OR WITHDRAW

Participation in this research project is completely voluntary. However, the audio taped interview section is very important. So, if you do not want the interview to be audio taped, you will not be able to participate in this study. You may choose not to answer specific questions or to stop participating at any time. If you withdraw from this project without completing all the four steps listed above, you will not be eligible for the $25 gift card.

COSTS AND COMPENSATION FOR BEING IN THE STUDY:

There are no costs associated with participation in this study. Upon completion of the second 24 hr food recall, you will receive a $25 gift card to Meijers as a token of appreciation for your participation.

CONTACT INFORMATION FOR QUESTIONS AND CONCERNS

If you have concerns or questions about this study or to report an injury, please contact the primary investigator:

Dr. Lorraine Weatherspoon PhD, RD
Associate Professor in Human Nutrition &
Director, Didactic Program in Dietetics
334 GM Trout Food Science Building
Michigan State University, East Lansing Michigan 48824-1224
Tel: 517-355-8474 ext 136
Email: weathe43@msu.edu

If you have questions or concerns about your role and rights as a research participant, or would like to register a complaint about this study, you may contact, anonymously if you wish, the Michigan State University's Human Research Protection Program at 517-355-2180, Fax 517-432-4503, or e-mail irb@msu.edu or regular mail at 202 Olds Hall, MSU, East Lansing, MI 48824.

DOCUMENTATION OF INFORMED CONSENT.

Your signature below means that you voluntarily agree to participate in this research study.

Printed name of the Participant: _____

_____ _____
Signature Date

You will be given a copy of this form to keep.

Appendix G: SL-ASIA Acculturation Instrument

INSTRUCTIONS: The questions, which follow are for the purpose of collecting information about your historical background as well as more recent behaviors which may be related to your cultural identity. Choose the one answer which best describes you.

1. What language can you speak?
    1. Indian only (for example, Hindi, Tamil, Telugu, Malayalam, etc.)
    2. Mostly Indian, some English
    3. Indian and English about equally well (bilingual)
    4. Mostly English, some Indian
    5. Only English

2. What language do you prefer?
    1. Indian only (for example, Hindi, Tamil, Telugu, Malayalam, etc.)
    2. Mostly Indian, some English
    3. Indian and English about equally well (bilingual)
    4. Mostly English, some Indian
    5. Only English

3. How do you identify yourself?
    1. Indian
    2. Asian
    3. Asian-American
    4. Indian-American.
    5. American

4. Which identification does (did) your mother use?
    1. Indian
    2. Asian
    3. Asian-American
    4. Indian-American
    5. American

5. Which identification does (did) your father use?
    1. Indian
    2. Asian
    3. Asian-American
    4. Indian-American
    5. American

6. What was the ethnic origin of the friends and peers you had, as a child up to age 6?
    1. Almost exclusively Indians, Indian-Americans
    2. Mostly Indians, Indian-Americans
    3. About equally Indian groups and Anglo groups
    4. Mostly Anglos, Blacks, Hispanics, or other non-Indian ethnic groups
    5. Almost exclusively Anglos, Blacks, Hispanics, or other non-Indian ethnic groups

7. What was the ethnic origin of the friends and peers you had, as a child from 6 to 18?
    1. Almost exclusively Indians, Indian-Americans
    2. Mostly Indians, Indian-Americans
    3. About equally Indian groups and Anglo groups
    4. Mostly Anglos, Blacks, Hispanics, or other non-Indian ethnic groups
    5. Almost exclusively Anglos, Blacks, Hispanics, or other non-Indian ethnic groups

8. Whom do you now associate with in the community?
    1. Almost exclusively Indians, Indian-Americans
    2. Mostly Indians, Indian-Americans
    3. About equally Indian groups and Anglo groups
    4. Mostly Anglos, Blacks, Hispanics, or other non-Indian ethnic groups
    5. Almost exclusively Anglos, Blacks, Hispanics, or other non-Indian ethnic groups

9. If you could pick, whom would you prefer to associate with in the community?
    1. Almost exclusively Indians, Indian-Americans
    2. Mostly Indians, Indian-Americans
    3. About equally Indian groups and Anglo groups
    4. Mostly Anglos, Blacks, Hispanics, or other non-Indian ethnic groups
    5. Almost exclusively Anglos, Blacks, Hispanics, or other non-Indian ethnic groups

10. What is your music preference?
    1. Only Indian music
    2. Mostly Indian
    3. Equally Indian and English
    4. Mostly English
    5. English only

11. What is your movie preference?
    1. Indian-language movies only
    2. Indian-language movies mostly
    3. Equally Indian and English-language movies
    4. Mostly English-language movies only
    5. English-language movies only

12. What generation are you? (circle the generation that best applies to you:)
    1. 1st Generation = I was born in India or country other than U.S.
    2. 2nd Generation = I was born in U.S., either parent was born in India or country other than U.S.
    3. 3rd Generation = I was born in U.S., both parents were born in U.S, and all grandparents born in India or country other than U.S.
    4. 4th Generation = I was born in U.S., both parents were born in U.S, and at least one grandparent born in India or country other than U.S. and one grandparent born in U.S.
    5. 5th Generation = I was born in U.S., both parents were born in U.S., and all grandparents also born in U.S.
    6. Don't know what generation best fits since I lack some information

13. Where were you raised?
    1. In India only
    2. Mostly in India, some in U.S.
    3. Equally in India and U.S.
    4. Mostly in U.S., some in India
    5. In U.S. only

14. What contact you have had with India?
    1. Raised one year or more in India
    2. Lived for less than one year in India
    3. Occasional visits to India
    4. Occasional communications (letters, phone calls, etc.) with people in India
    5. No exposure or communications with people in India

15. What is your food preference at home?
    1. Exclusively Indian food
    2. Mostly Indian food, some American
    3. About equally Indian and American
    4. Mostly American food
    5. Exclusively American food

16. What is your food preference in restaurants?
    1. Exclusively Indian food
    2. Mostly Indian food, some American
    3. About equally Indian and American
    4. Mostly American food
    5. Exclusively American food

17. Do you
    1. read only an Indian language
    2. read an Indian language better than English
    3. read both Indian and English equally well
    4. read English better than an Indian language
    5. read only English

18. Do you
    1. write only an Indian language
    2. write an Indian language better than English
    3. write both Indian and English equally well
    4. write English better than an Indian language
    5. write only English

19. If you consider yourself a member of the Indian group (Indian, Indian-American, etc., whatever term you prefer), how much pride do you have in this group?
    1. Extremely proud
    2. Moderately proud
    3. Little pride
    4. No pride but do not feel negative toward group
    5. No pride but do feel negative toward group

20. How would you rate yourself?
    1. Very Indian
    2. Mostly Indian
    3. Bicultural
    4. Mostly Westernized
    5. Very Westernized

21. Do you participate in Indian occasions, holidays, traditions, etc?
    1. Nearly all
    2. Most of them
    3. Some of them
    4. A few of them
    5. None at all

22. Rate yourself on how much you believe in Indian values (e.g., about marriage, families, education, work):

1	2	3	4	5
(do not believe)				(Strongly believe in Indian values)

23. Rate yourself on how much you believe in American (western) values:

1	2	3	4	5
(do not believe)				(Strongly believe in American values)

24. Rate yourself on how well you fit with other Indians:

1	2	3	4	5
(do not fit)				(fit very well)

25. Rate yourself on how well you fit when with other Americans who are non-Indian (westerners):

1	2	3	4	5
(do not fit)				(fit very well)

26. There are many different ways in which people think of themselves. Which ONE of the following most closely describes how you view yourself?

1. *I consider myself basically an Indian. Even though I live and work in America, I still view myself basically as an Indian.*

2. *I consider myself basically as an American. Even though I have an Indian background and characteristics, I still view myself basically as an American.*

3. *I consider myself as an Indian-American, although deep down I always know I am an Indian.*

4. *I consider myself as an Indian-American, although deep down, I view myself as an American first.*

5. *I consider myself as an Indian-American. I have both Indian and American characteristics, and I view myself as a blend of both.*

Appendix H: 24-Hour Dietary Recall

Getting started

- Break the ice
- Explain why the assessment is being done
- Reassure the subject this will be kept confidential

USDA 5-Step Approach

1. Quick List – Collect a list of foods and beverages consumed the previous day
- What was the 1st thing you ate after you got up yesterday?
    - Avoid terms like breakfast or lunch
- Record only food at this time; don't worry about portion sizes until later
- Allow extra space for adding things later
- Do NOT interrupt

2. Forgotten Foods – Probe for foods forgotten during the Quick List
- Your turn to talk
- Probe with open ended questions (how, what, describe)
- Don't forget…
    - Condiments
    - Beverages
    - Alcohol
    - "Little bites" of food
- Frequently missed foods

3. Time & Occasion – Collect time and eating occasion for each food
- Review the day to them
- Ask the subject to tell you the time of day each food was eaten
- Ask if there are additions or corrections

4. Detail Cycle – For each food, collect detailed description, amount, and additions. Review 24-hour day
- Obtain 4 kinds of info about each food/beverage
- Kind of food/Beverage
    - Fresh, frozen, canned
    - Skim, 2%, whole
- Preparation of food
    - Fried or baked
    - Ingredients added
- Portion size of food
    - Participant may underestimate so use models or examples
    - Make sure EVERY item has some measuring unit
- How served
    - Butter, gravy, or cream added?
- If you are not sure about a food, ask the participant to describe it to you
    - For example, Joe tells you he has a Gatorade® every morning after breakfast
    - Find out what is a Gatorade®…
        - Is it a drink?
        - An energy bar?
- Get details (color, ingredients, etc)
    - Your mom's BBQ is not going to be the same as his/her mom's
- Record dietary supplements or vitamins/minerals
- Record any herbal or home remedies

5. Final Probe – Final probe for anything else consumed
- Remember…
    - Double-check name on each dietary assessment form
    - Check for completeness

24-HOUR DIETARY RECALL SHEET

Date:_____ Day of the week_____

Time of the Day	Food Items	Amount/Portion	What were you doing?	Where were you eating?

"Was this a normal day?" yes or no If no, specify_____

"Do you take vitamin or mineral supplements " yes or no If yes specify_____

Appendix I: Table I.1. Codebook for Qualitative Analysis.

Code	Tag	Definition	Rule for application	Example
Is acculturation related to glycemic control, and if so, how?				
Lifestyle changes after immigration	Achg	Changes in actions, beliefs, values after immigration to the U.S.	Applied when reference to changes in lifestyle after coming to the U.S. Examples: change in mentality, approach, doing house chores, changes in smoking, drinking, eating, exercise habits etc.	"I mean I had drunk in India as well, so but that was a non continuous, non regular, irregular, but now I drink regularly"
Management of diabetes in India/ U.S.	Aind	Views about how lifestyle in India or the U.S. is in favor of or hinder self-management of diabetes	Applied when reference to lifestyle, people, food exposures, family etc. in India and/or the U.S. pertaining to self-management of diabetes	"when I went to my mom's house recently, and I ate just a little bit of rice and I ate a whole bunch of vegetables she said " my God what are you doing?" you know... and they are simply shocked to see how much... how very little rice we eat"
How do participants perceive the impact of the disease and the required self-management behaviors?				
Lifestyle modifications after diagnosis	Plife	Views on modifications in their daily routine after being diagnosed with diabetes	Applied when reference to making changes in lifestyle after being diagnosed with diabetes. Concepts to look for: Eating habbits, exercise habbits, taking prescribed medications, weight control, self-monitoring of blood glucose, foot care and check-up with a physician.	"I am eating more healthy, definitely and I am right now, see I wasn't exercising regularly before and I wouldn't take proper care of myself but I don't know, this realization has dawned one me recently so I am doing much better job of it"

Table I.1. Codebook for Qualitative Analysis (cont.).

Code	Tag	Definition	Rule for application	Example
What do subjects perceive to be facilitators and barriers for better managing their diabetes?				
Barriers	Bar	Anything that restrains or makes it difficult to take care of diabetes	Applied when reference to not being able to manage diabetes well due to certain reasons or conditions. Concepts to look for: lack of time, lack of motivation, forget or ignore self management behaviors, availability of instrument, visitors form India, food, exercise, old age, climate, poor health care, availability of Indian medicines etc.	"Other thing I feel, that I find it difficult is to find a time for myself. I run around for my children's activities after my work, I take them to their classes at the same time I don't assign an hour or two's time once or twice a week for me to go work out"
Facilitators	Fac	Anything that helps or makes it easier to take care of diabetes	Applied when reference to being able to manage diabetes well due to certain reasons or conditions. Concepts to look for: food management, exericse habbits, awareness of the disease, taking regular medications, location of residence, living in the U.S. , taking Indian medicines, talk to others etc.	"My wife gives vegetables so I try to eat as much as...you know, so that helps to cutting down the carbohydrates. I don't do alcohol, or sweet or smoking or other things. My daily living discipline is disciplined except the weekends but average base is a good discipline"
How does an individual's values and beliefs influence self-management behaviors?				
Religion	Vrel	Perceptions about having or showing belief in and reverence for God or a deity	Applied when reference to religious experiences and beliefs about God	"I belong to a religion and I believe the religious.... its like a social security number. I am a sikh, I will always be a sikh and my wife is also very supportive of it and she does the same thing"
Alternative Indian medicine	Vaim	Perceptions and beliefs about Indian treatment	Applied when reference to thoughts about Indian medicines or treatment methods	"I am going to try the Siddha medication, that is why I brought is but I haven't started it yet"

Table I.1. Codebook for Qualitative Analysis (cont.).

Code	Tag	Definition	Rule for application	Example
Functional foods	Vfun	Foods believed to be helpful with diabetes management	Applied when reference to beliefs on certain foods to be helpful in managing diabetes	"They say the cinnamon helps you with your diabetes, I tried it a few days. Also the fenugreek but the I forget to eat them. Those are the two that I know of..and oatmeal ofcourse, oatmeal helps me tremendously ever morning I eat oatmeal for my breakfast regularly during weekdays"
How does the subjects' knowledge of diabetes affect their self-management behaviors?				
Understanding	Kund	Awareness of the origin, mechanism and/or course of the disease	Applied when respondent references their views for the question "what is diabetes?"	"It has to do with insulin, that your body either doesnt get enough insulin or it is not regularly released in blood. So then the sugar stays in.....god...they say that insulin is like a key to the....insulin needs to be there in your blood that allows the sugar to go through the cells so here since you either have less insulin or not released regularly, the sugars stays in your blood for a longer time"
Consequences	Kcons	Knowledge about some of the problems and complications of the disease	Applied when respondent references their views for the question "what do you think will happen if you do not take care of your diabetes?"	"Well, I have...I have heard, I have learned that you could have heart problem, you can have eye problem, you can have kidney failure...or you can have...hmm.... I don't know there were problem or some other...these are the main things"

Table I.1. Codebook for Qualitative Analysis (cont.).

Code	Tag	Definition	Rule for application	Example
Benefits	Kben	Knowledge about some of the advantages of having good control of diabetes	Applied when respondent references their views for the question "what are some of the benefits ofmanaging your diabetes?"	"You can prolong life and maintain your health, you know stabilize so that's, you can try to do the normal life"
Resources	Kres	Resources used to learn about diabetes and self-management behaviors	Applied when reference to sources that helped participants to gain information about diabetes. Examples: by reading books, browsing internet, diabetes classes, health care facility, community etc	"Diabetes education tremendously helped me while I was pregnant. They talked about, there was more emphasis on how it affects the child along with you, the child that is not born yet. At the same time they provided information about how it hurts your organs too"
Role of exercise	Rex	Understanding of the function of physical activity in diabetes management	Applied when reference to part played by physical activity in relation to diabetes management. Applied when respondent references their views for the question "what do you think is the role of exercise in managing diabetes?"	"That also plays a very important role. You have to exercise not only for your diabetes but to keep your energy level up, you know, for your heart and your muscles, your bones, for your musculo-skeletal system"
Role of Food	Rfood	Understanding of the function of foods and eating habits in managing diabetes	Applied when reference to part played by food and food habits in relation to diabetes management. Applied when respondent references their views for the question "what do you think is the role of food in managing diabetes?"	"Food is a must, to me you know. Food is main role because I feel if anything eat more than normal the sugar going to jump. Food is the killer"
Role of medicine	Rmed	Understanding of the function of tablets/injections in managing diabetes	Applied when reference to part played by medicine in relation to diabetes management. Applied when respondent references their views for the question "what do you think is the role of medicine in managing diabetes?"	"See sometimes your exercise and when you diet is not very helpful, and you definitely need medications and now you have like better medications I am thinking, to help with"

Table I.1. Codebook for Qualitative Analysis (cont.).

Code	Tag	Definition	Rule for application	Example
How does the health care system influence self-management behaviors?				
Physician care	Hcare	Experiences about the medical care provided by the doctor/ health care system	Applied when reference to positive, negative or neutral feelings towards the medical care provided by the doctor	" of course health care is my own choice, even though my doctor is 15 miles away from where I live, I still go to him because I like him very much. He is a professional, so I continue to go to him"
Role of physician	Hrole	Expectations out of a doctor in helping patients to control their diabetes	Applied when reference to the part a doctor should play in helping with the patients to control their diabetes. Examples: Doctor should be knowledgeable, supportive, approachable, aggressive, willing to educate the patients etc	"See.... If the person, the patient it not aware of the problems, if they are not aware of the condition, I think the doctor should be very well informed ..."
In what ways are support networks and self-management related?				
Support from friends, family or community	Snet	Help and support provided by friends in managing diabetes	Applied when reference to friends as those who are very helpful currently and/or during the time of diagnosis with diabetes management	"I talk to all my friends I would say, I talked about it very openly, I wasn't shy so this was something that my friends get to knew and they were very supportive, they helped me out"
How does location of residence influence self-management behaviors?				
Perceptions about location and neighbors	Ploc	Description of the area/place and experiences living there	Applied when reference to the nature of residence and how the participant feels to live there	"Farmington hills has a lot of Indian nationals, so it's a good community to be with"

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